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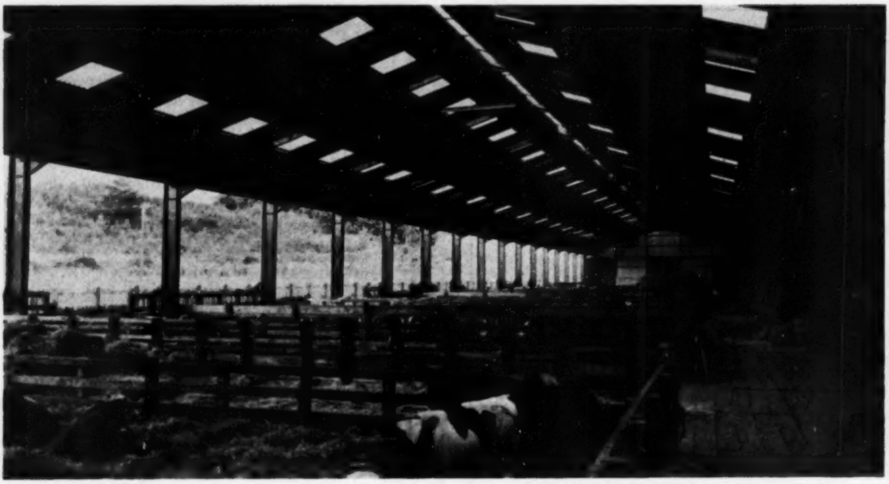

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Contents

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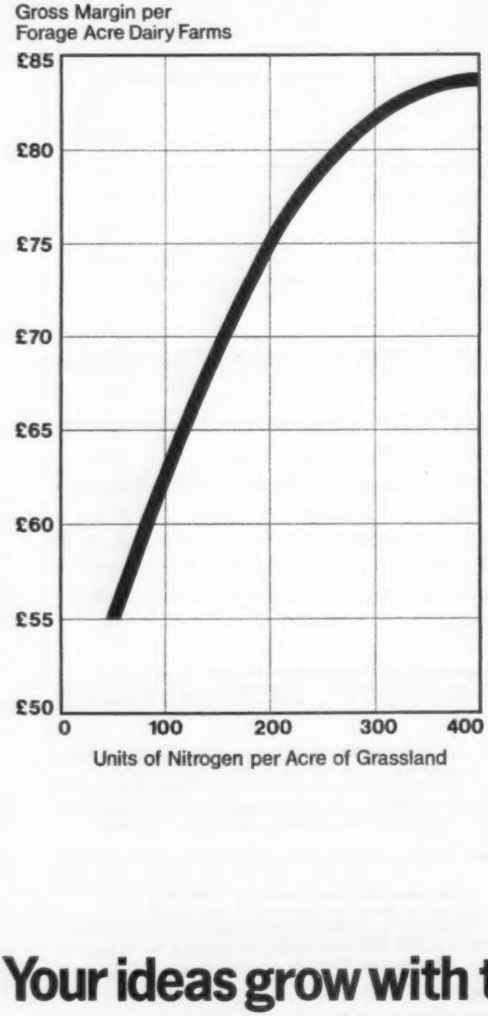
Nitrogen-

The key to profitable milk production



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Head of affected lamb. Note domed head, pigmentation and kempy fleece

This article describes a disease of sheep which seriously affects the lamb during its development in the womb.

Border Disease of Sheep (Hypomyelinogenesis)

I. G. Shaw

'THERE is nothing new under the sun' and although we tend to look upon Border Disease (Hypomyelinogenesis) as a new condition, probably it has been in existence for at least eighty years. During the first spring following the opening of the Worcester Veterinary Investigation Centre in 1956, our attention was drawn to the presence in some flocks of lambs showing unusual symptoms. We now know that the disease is characterized by changes in the fleece and body conformation, accompanied sometimes by nervous symptoms, and that it is caused by a so far unidentified infectious agent.

Physical symptoms

The disease is usually easy to identify, particularly after some experience, and is best looked for in a flock at the peak of lambing. In typical cases the lamb shows an abnormal birth coat, which often contains a number of 'halo hairs' projecting above the normal, woolly fibres to give the lamb a fuzzy appearance. The proportion of these fibres can vary greatly, but they tend to fall out at about three weeks, making identification of affected lambs

more difficult after this age. In others, the normal woolly birth coat may be replaced to a variable degree by coarser kempy fibres and in extreme cases the fleece resembles that of a Welsh mountain lamb. In some breeds, the birth coat is naturally pigmented; this disappears in a few weeks but in affected lambs there is a tendency for the pigmentation to be exaggerated and it may persist throughout life.

The natural conformation of the body is changed. Affected lambs tend to have a stocky appearance, their bodies appearing short and thick, the legs shortened and the head domed, in contrast to the lithe appearance of normal lambs.

Nervous symptoms

Nervous symptoms are seen in a minority of affected lambs as rhythmic muscular contractions of various groups of muscles. The so-called 'shakers' are easily identified in the flock. In a few instances small groups of muscles are involved, producing only a slight twitch of the ear, tail or body, which can go un-noticed unless the observer knows what to look for. These symptoms are apparent from birth and are made worse by hustling the lamb. If the animals survive symptoms can regress to some extent. Shakers may also show altered body conformation and abnormal fleece.

Effects of disease

The number of lambs affected in a flock and the severity of the disease in individual animals varies considerably. In primary outbreaks, when severe, it is not uncommon to see up to half the lamb crop affected, at times even more. In others, the symptoms are so slight that it is almost impossible to detect anything wrong. In the case of twins one or both can be affected. The ewes themselves show no symptoms apart from producing affected lambs but it has been found experimentally that if hoggs are infected at their first pregnancy their subsequent growth rate is retarded.

Apart from causing the birth of deformed lambs Border Disease has profound and damaging effects upon the developing embryo and foetus in the womb, leading to early death of the foetus with subsequent resorption, abortion or stillbirth.

Growth is retarded and at any age the lambs are liable to lose condition in a few days, develop a scour and die. Affected lambs are seldom profitable, are unsuitable for breeding and are best sold for slaughter if they can be made to put on sufficient flesh. Both sexes, equally, are very susceptible to such debilitating diseases as parasitism, pneumonia and stress conditions.

Flock history

Primary outbreaks are generally severe because the animals have no resistance to the disease. Once the flock is infected the disease will persist indefinitely but with less severity, except in the hoggs, which generally produce severely affected lambs during the first pregnancy. The lamb crop from the ewes is only slightly affected, if at all. The explanation for this is that the hoggs are infected during their first pregnancy and because of the absence of any immunity the disease produces a maximum effect. During subsequent pregnancies the immunity, which will by that time have developed, allows them to produce normal lambs. Situations do arise whereby ewes do not become infected until their second or subsequent pregnancies. Here the

pregnancy, coinciding with infection, produces a high proportion of affected lambs, subsequent pregnancies being normal.

Breeds affected

The Worcester V.I. Centre first encountered the condition in the border counties between England and Wales (hence the name Border Disease) where both the Clun Forest and Kerry Hill breeds are predominant and indigenous. However, investigations show that the disease is present not only in other breeds and in other parts of the country but also in other parts of the world. This is a familiar pattern; once a disease has been recognized and described in a particular locality, reports soon appear of its presence elsewhere.

Clun lambs. Normal animal on right, affected animal on left

Experimental work

When confronted with a new disease it is usual to try to put forward a theory of the cause and to try to test it. Some of the features of Border Disease fitted in with a genetic cause, others led us to the conclusion that an infectious agent might be responsible. To test the validity of this the V.I. Centre inoculated pregnant ewes which were free of the disease with tissues from infected lambs; they gave birth to affected offspring and this pointed the way for our investigations.

It was found that the foetus is susceptible to infection between the 8th and 52nd days of pregnancy. Apart from early foetal death and abortion already referred to, it is now possible to measure the effects of the casual agent upon the organs, skeleton and skin of the lamb.

The nervous system of 'shaker' lambs is less well developed and shows a lack of white matter (myelin)*, hence the more scientific name for the disease, hypomyelinogenesis, meaning the deficient laying down of myelin during its development. Attempts to infect (vaccinate) ewes before pregnancy, and to challenge (infect) them again during pregnancy, reduced the effects of the

*Nerve fibres are of two types: white fibres which have a fatty sheath of myelin and grey fibres which are unsheathed.

disease, but not sufficiently to warrant the development of a vaccine at this stage of investigation. Similarly, attempts to identify affected animals or carriers by various laboratory tests have not yet been successful. No treatment is available nor has the casual agent been identified. Experimentally it has not yet been possible to demonstrate satisfactorily how transmission of the disease occurs, but from field experience it seems likely that it is infectious and transmission occurs both vertically, from parent to offspring, and laterally, from one sheep to another. The role of the ram is also suspect. It is possible that transmission occurs during the running together of infected and non-infected sheep, particularly at tupping time and during pregnancy, while contamination of the environment by the infective agent may be particularly heavy during abortion and lambing.

Incidence

At the present time, the extent of the disease in Britain is not known accurately and further knowledge will depend upon how readily it is recognized. It is suspected that in some flocks it is so slight as to be difficult to detect, but it has been suggested that it could be one of the causes of 'tail ender' lambs. In some areas the incidence of Border Disease is high and it appears to persist from year to year.

It is impossible to give any indication of economic loss, since the disease is so variable and its effects difficult to measure. Without knowing the national incidence it is not possible to estimate the loss to the sheep industry as a whole, but certainly a severe outbreak in a flock is alarming and leads to heavy financial loss.

Prevention

Until more is known about the casual agent, the precise mechanism of immunity and the routes of transmission it is impossible to make precise preventive recommendations. In the event of an outbreak the following suggestions are worthy of consideration:

(*a*) Sell out all affected lambs and their parents, e.g., ewes, rams and lambs. Start again by purchasing unaffected animals; or

(*b*) As the subsequent crops of lambs produced by an affected flock are likely to be very much less severely affected by reason of immunity acquired during the previous pregnancy, the retention of the breeding flock could be considered; or

(*c*) Mix purchased ewes with unaffected ewes well before tupping in the hope that the former will become infected and immune before becoming pregnant; or

(*d*) If practicable, keep both the affected and the unaffected flocks entirely separate, each year decreasing the former and building up the latter.

Acknowledgment

Investigations began at the Worcester V.I. Centre and have developed on a collaborative basis. Thanks are due to our colleagues at the Central Veterinary Laboratory, Weybridge and at the Moredun Institute, Edinburgh. The help given by flock owners and veterinary surgeons is also gratefully acknowledged.

The author, **I. G. Shaw, B.V.Sc., M.R.C.V.S.**, is a Veterinary Investigation Officer with the Ministry at Worcester.

Trials at Ministry Experimental
Husbandry Farms may lead to

New Ideas for Rationing Cows

M. J. Strickland

THERE may be a much simpler and more efficient way of rationing dairy cows than by the old '4lb/gal' method. This article explains the work being pursued at Experimental Husbandry Farms to develop a system whereby, after determining the potential yield of a cow by recording on a single day soon after calving, fixed levels of concentrates are fed thereafter according to a pre-determined programme and regardless of yield. Preliminary results suggest that this new system may give as much, if not more, milk than conventional rationing from the same amount of concentrates.

There are many disadvantages in the 4lb per gallon type of rationing. For a start, the system involves a considerable amount of recording work as well as individual cow marking and identification. The whole concept that concentrate feeding should be directly related to milk yield has also been challenged by work at the National Institute for Research in Dairying. In theory one replaces the amount of nutrients taken out by one gallon of milk by feeding 4lb of concentrates. This assumes that the cow is in a state of equilibrium, i.e., is neither gaining nor losing weight. In practice, however, all cows lose approximately 80lb during the first 10 weeks of lactation and thereafter tend to gain in weight until calving. In other words a cow requires different levels of nutrients according to her stage of lactation and this is not taken into account when feeding is based on milk yield alone. It is also known that more feed is required for, say, the fourth gallon of milk produced than for the first gallon. What alternative systems of rationing, then, are available?

How to ration concentrates

To answer the question of how concentrates should be fed to cows throughout the lactation, a large scale co-ordinated experiment was started in 1965 at four Experimental Husbandry Farms—Boxworth, Bridget's, Great House and Trawscoed. This involved feeding cows at different flat rates of concentrates irrespective of their milk yields for various periods of the lactation. The actual levels of concentrates were 25, 20 and 15lb per day fed with a basal ration of hay; rates for heifers were 4lb a day less. In addition, one group was fed at 4lb per gallon with a lead feed of 4lb of concentrates per

day for the first 6 weeks. Details of the trial, which involved 189 autumn calving Friesians, are given in Table 1.

Table 1

Outline of feeding treatments

Week of lactation	*Concentrates fed (lb/day)*
1—2	8 rising to 20
3—10	25, 20 or 15
11—18	20 or 15
18 to turnout	13
at grass	nil

In addition one group was fed at 4lb per gallon

Several points of practical importance have emerged from the trials. The first of these was to demonstrate that the effect of feeding a high level of concentrates for a limited period persists long after the actual period of feeding. This residual effect was approximately three times as great as the immediate response to concentrate feeding. The effect of feeding concentrates during weeks 3–10 of lactation is shown in Table 2.

Table 2

Effect of early feeding of concentrates—cows (gallons of milk produced) per head

Period	*Concentrates fed (lb/day) weeks 3 to 10*			*4lb/gall.*
	25	20	15	
3 to 10 weeks	280	266	245	262
Lactation total	972	945	864	894

These results have been averaged over the two levels of concentrates in weeks 11–18 so that after week 10 all groups received the same feed.

Long-term effect

The figures show that feeding 25lb of concentrates per day during weeks 3–10 produced only 35 gallons more milk than when 15lb of concentrates were fed. This was clearly uneconomic since the additional 5 cwt of concentrates fed might cost approximately £10 for an additional milk return, at say 20p per gallon, of £7. However, when the effect of this early feeding is assessed over the whole lactation the picture is very different. Feeding the extra 5 cwt in weeks 3–10 produced over 100 gallons more milk when taken over the whole lactation. The residual effect of concentrate feeding is, therefore, 2–3 times more important than the immediate effect.

Taking into account the long-term effect of any winter feeding, treatment is becoming an increasingly important aspect today. The effect of winter concentrate feeding can persist from one lactation to another, particularly in situations of high stocking rates where an animal finishing one winter under weight has little chance to make up body weight before the next calving. This will tend to lead to lower yields in the second winter. Too low feeding has also been shown in other experiments to affect fertility, though in the A.D.A.S. trials under review there was little effect on conception from concentrate feeding.

The results showed that the flat rate feeding treatments produced more yield than the group fed at 4lb per gallon. In fact the group fed 25lb of concentrates followed by 15lb consumed the same amount of concentrates—

about 23 cwt over the winter period—but produced about 55 gallons more milk over the whole lactation. This picture was not reproduced with heifers but the results do indicate that a simpler form of rationing may possibly give equally good results. How this might be done was indicated by the heifer results shown in Table 3.

Cow potential

From the heifers at Great House it was seen that animals producing a high initial milk yield in the first 14 days after calving produced considerably more milk from a given amount of concentrates that those which gave a smaller initial yield. The two heifer groups may be divided into a low potential group, i.e., those producing about 2½ gallons per day in the first 2 weeks after calving, and a high potential group producing 3½ gallons per day. The levels of concentrates were 4lb per day lower than for cows but the equivalent results are given in Table 3.

Table 3

Effect of early feeding of concentrates—heifers (gallons of milk produced)

Week of lactation	*Concentrates fed (lb/day)*		
	21	16	11
Low potential heifers			
3—10	169	153	159
301 days	617	605	633
High potential heifers			
3—10	238	212	172
301 days	913	763	735

The low potential heifers gave very little extra milk from additional concentrate feeding, either in the short term, during weeks 3–10, or over the whole lactation. The high potential group, however, gave a considerable response to extra feed—about 180 gallons over the whole lactation—from the higher early concentrate feeding.

These results clearly illustrate the importance of feeding according to the potential of the animal; this may explain in part why the traditional system of rationing at 4lb per gallon is so successful. At least it relates the feed to the potential of the cow or heifer, the higher yielders automatically receiving more feed. How, therefore, can rationing be improved for the future?

New rationing system

The answer lies partly in the Great House heifer results because these may point the way to a new system of rationing concentrates. If the milking potential of the cow can be judged in the first 2 weeks after calving, say by recording the yield on day 8 after calving, it may be possible to recommend a flat rate of feeding concentrates for the remainder of the lactation with possibly a reduction in feed at 10 weeks and 20 weeks of lactation.

These are only ideas at present but work is in progress at the four A.D.A.S. Experimental Husbandry Farms to see whether milk yields can be increased by this simpler form of rationing and recording.

The author **M. J. Strickland, M.A.(Oxon.), D.T.A.**, is the Deputy Director at Boxworth Experimental Husbandry Farm.

Provided schemes are properly designed, there are advantages to be gained from

Open Ditch Elimination

J. McCunnall

As farm costs continue to rise it is becoming more and more necessary to look critically at all aspects of the farm enterprise to see if any savings can be made. One way in which costs can be reduced is by eliminating open ditches and hedges where this is really feasible. The indiscriminate elimination of ditches must be avoided and each length must be examined carefully. Attention must also be paid to the needs of nature conservation which in some cases may be the overriding consideration.

Benefits

What are the benefits that can be obtained by eliminating open ditches? There are several which are obvious. By running small fields together, machinery can be used more economically and any reduction in non productive time spent turning, loading and unloading and travelling between fields must result in increased output. It has been estimated that with a row run of 100 yards the amount of time lost might be 15 per cent whereas with a run of 500 yards it can be as low as 3½ per cent. The saving in time increases as row length increases up to a distance of about 750 yards and in order to obtain the advantage of cultivating in two directions a field size of some 500 yards by 500 yards (50 acres) is thought to be the most suitable. Another consideration is that in each separate field there are travelling, preparatory and finishing-off periods during which output is below normal working level.

The reduction of headlands and the area formerly occupied by hedges and ditches increases the acreage available for cropping and stocking. This is particularly the case where ditch maintenance has been neglected and the hedges have been allowed to run wild affecting a wide strip of land. Elimination can put this right.

Ditch maintenance is a costly item and failure to carry it out can prove disastrous. In the past, when labour was much more readily available, ditching and hedging work was often looked upon as a means of keeping men employed when they were not required for other jobs; those days have long since gone and anything that can be done to reduce the amount of ditch maintenance must be an advantage. It is true that there are various efficient ditch maintenance machines on the market but the purchase and operation of a machine still costs money.

Fig. 1 shows a ditch elimination scheme carried out recently in Kent. This was on a block of land of just over 100 acres divided into fourteen separate fields with acreages ranging from just under one acre to slightly over fifteen.

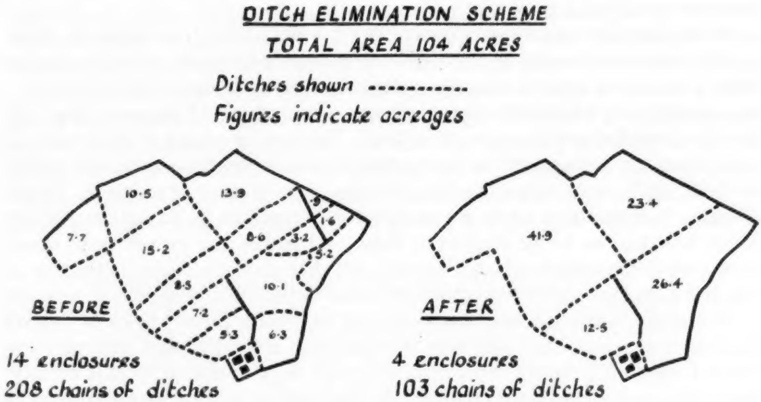


Fig. 1

The total length of ditches was 208 chains. An intensive underdrainage scheme was installed which reduced the number of fields to four, with acreages of 42, 23, 26 and 12 and the length of ditching to 103 chains. There was an immediate saving of £800—the estimated cost of putting the ditches into good order—and a further saving of around £75 a year in maintenance costs. In addition 2½ acres was gained for cropping, the purchase value of similar land in the district being approximately £250 per acre. In this particular scheme no expense was incurred in actually piping the ditches as the thorough nature of the underdrainage system made this unnecessary; the only extra cost was for bulldozing spoil to fill in and level off the ditches.

There are other reasons for getting rid of open ditches; for example, where unstable soils result in frequent bank slipping, bed erosion or bank undercutting. In some cases no amount of careful attention can permanently overcome these problems. Also, where ditches are close to farm tracks and roads, they often prove a serious hazard to men, stock and machinery. Based on the figures for England and Wales for the past four years, 31 fatal accidents are caused by tractors overturning every year and in the majority of cases ditches have been at least partly responsible.

Although these are some of the benefits to be gained by eliminating ditches it is unfortunately not quite so straightforward as there are instances where filling in an open ditch can give rise to trouble.

Whether to pipe

Our predecessors usually had very good reasons for digging ditches where they did; therefore, before a decision to fill in one is made the function of the ditch must be carefully determined.

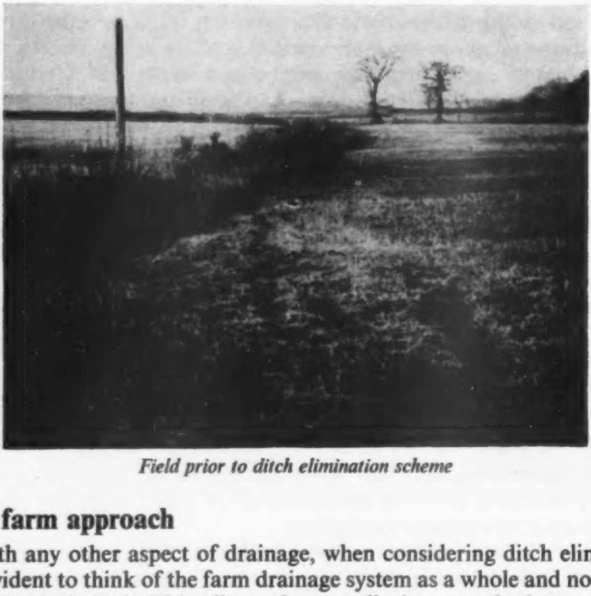
In many cases these functions can be taken over by a pipe quite satisfactorily. For example, where the main purpose of a ditch is to intercept underground water, a pipe drain with permeable filling can be equally satisfactory.

Again, where a ditch acts only as a collector of underdrain outfalls, then this too can be replaced by a pipe.

There are other situations where piping is a possibility. For example, when a ditch is a minor carrier and merely conveys water from one point to another then it need not remain open provided that the quantity of water it carries can pass through a pipe of reasonable size. Pipes above 12 inches in diameter tend to be ruled out on account of cost. The cost of piping a ditch with 12 inch diameter pipes might be in the region of £35 per chain, whereas piping with 30 inch pipes could be four or five or even more times that figure. Ditches in marshland areas are sometimes thought to be cheap barriers for stock but this can be an illusion as these 'wet fences' are expensive to maintain and if maintenance is not carried out they either become ineffective or require such high water levels that the value of the grazing is greatly reduced.

There are some ditches which should never be piped. Surface run-off interceptors are an example; here an open ditch is the simplest, cheapest and most foolproof solution. Soil erosion is not very common in this country but where it is found correctly sited ditches help to minimize the damage by intercepting small surface flows which, if allowed to join up, could cause serious trouble. Major carrier ditches should not be piped because frequently they have to carry large quantities of water and the cost of providing pipes of adequate size to replace them would be prohibitive.

It is quite likely that a ditch has more than one function. For example it might be a minor carrier, a collector of flow from underdrainage outfalls and a surface water interceptor. All sorts of permutations are possible. Its purpose must, therefore, be carefully investigated before any decision to pipe it in is taken.



Field prior to ditch elimination scheme

Whole farm approach

As with any other aspect of drainage, when considering ditch elimination it is provident to think of the farm drainage system as a whole and not merely of an individual ditch. This allows the overall picture to be borne in mind

and avoids a piecemeal job which could lead to an unsatisfactory overall solution and probably to extra expense in the long run. In this article the expression 'open ditch elimination' is used rather than 'piping a ditch' because piping a ditch might convey the idea that when ditches are being replaced by pipes the pipes are laid in the actual bed of the old channel. Sometimes this method is in order but often there are disadvantages as it is not always possible to get a firm bed for the pipes in the soft conditions of an old ditch bottom. Also there is a risk that existing underdrains in the bank may be overlooked. It is often advisable to lay pipes in the ditch bank on the higher side in order to obtain good bedding conditions and also to bring to light any old underdrains which can then be easily connected up to

Same field as photograph on page 382, after ditch elimination scheme

the new pipe. In some cases, especially in marsh and fen areas, the laying of comprehensive underdrainage systems with laterals running close to the old ditches may do away with the need for pipes to be laid along the actual line of the ditch.

Design

When replacing an open ditch by pipes it is of prime importance that the pipes are of adequate diameter. When, exceptionally, storm flows occur open ditches can usually carry three or four or even more times the normal flow without harm. On the other hand, once a pipe is full it can be made to pass more water only by being surcharged, and even then it will take only a fraction of the amount that an open ditch could carry under similar circumstances.

It is essential that pipe inlets and outlets should be properly designed as these are the most vulnerable points of the system. They should have substantial headwalls and wingwalls and in the case of inlets a silt trap at least 12 inches deep and a trash grating set back from the pipe should also be provided. Inspection chambers are necessary in long pipelines or where there are pronounced changes in direction or gradient. Also, where gradients are steep the pipe joints should be positively sealed.

In a Ministry survey of 700 piped ditch systems over 10-years old, 260 were found to have defects and in many cases had ceased to function. The most common faults were damaged or impeded inlet (100 cases) and obstructed outfall (110); blockages along the line of pipes and inadequate pipe size accounted for most of the remainder. Suffice to say that had proper attention been paid to inlet and outlet design and regular maintenance very few of these troubles would have occurred.

It cannot be too strongly emphasized that ditch elimination is not something which can be lightly undertaken and that specialist advice should always be obtained. However, where properly designed schemes are installed there can be a considerable saving to the farmer in time and money with very little risk attached.

The author, **J. McCunnall,** is an A.D.A.S. Divisional Drainage and Water Supplies officer, stationed at Maidstone, Kent.

Clayware Field Drain Pipes in Metric Sizes

Clayware field drain pipes, which play an important part in the drainage of agricultural land, have hitherto been manufactured in imperial sizes, but the British Standards Institution has now published a standard for such pipes, in metric (SI) units, which will nevertheless have adequate tolerances to be interchangeable with those made to the old standard.

The metrication of BS 1196 *Clayware field drain pipes** is technically unchanged but the dimensions of the pipes are now presented in a manner which accords with modern usage, i.e., by specification of nominal bore and maximum and minimum limits of internal diameter. The standard includes clauses on quality, workmanship and an appendix contains a crushing test for the pipes which is intended to assure that they can withstand the severe loads to which they may be subjected by constant passage overground of modern agricultural machinery.

*Obtainable from the British Standards Institution, Sales Branch, 101 Pentonville Road, London N1 9ND, price (to non-subscribers) 50p, including postage, remittance with order.

Sykes Field, Boxworth: fourteenth wheat crop in 1965, *the sixteenth corn crop in succession*

Continuous Winter Wheat

M. Selman, *Boxworth E.H.F.*

GROWING continuous winter wheat is not a new venture. On Broadbalk Field at Rothamsted Experimental Station wheat only was grown from 1844 until recently; and Prout and Son, farmers at Sawbridgeworth in Hertfordshire, took long runs of wheat between 1861 and 1906 without being overwhelmed by disaster.

Co-ordinated trials at Boxworth, High Mowthorpe and Rosemaund Experimental Husbandry Farms have shown winter wheat monocultures to be technically feasible on some soils. However, yields have fallen as consecutive crops were grown further from the break. At the first two farms, by the time the fourth or fifth crop was reached yields at optimum nitrogen level had fallen to 80 and 70 per cent respectively of the yield at the first harvest; at Rosemaund yields were down to 70 per cent by the third crop. After these low points were reached yields tended to improve slowly or to stabilize. It may be of some significance that improvement was most dramatic where yields fell fastest, i.e., at Rosemaund.

In addition to these main trials, small scale commercial continuous crops of about seven acres each have been grown at Bridget's, Boxworth, Drayton and High Mowthorpe for several years. The reasons for falling yields have

not always been clear but grass weeds have been a major problem on these sites on every farm. If these can be checked yields of continuous wheat may eventually stabilize; at Boxworth, for example, they have levelled off at an average of about 33 cwt per acre.

However, although winter wheat monocultures are technically feasible they are much more difficult to operate than continuous spring barley. The safety margin is much less and the reward usually little greater, though much of course depends on relative prices. All the problems associated with intensive cereals are liable to become magnified as one goes beyond a second consecutive winter wheat crop.

Yields

Intensive, as opposed to continuous, growing of wheat has long been practised in parts of East Anglia and up to three crops are quite often taken before changing to spring barley or a break crop. Some of the problems involved in doing this were outlined by the author in *Agriculture*, January 1970. In the past, one of the biggest problems has been the incidence of the grass weeds blackgrass, wild oats and couch. Take-all has less often been a problem at Boxworth, though elsewhere it can rapidly become the limiting factor.

In our trials, even where strenuous attempts to control grass weeds have met with reasonable success and where take-all has not been a menace, yields have declined for several years as the break crop receded into the past. Actual yields of first to fourth crops in our trial at Boxworth are shown in Table 1 and the decline trend as a percentage is shown on the graph at Fig. 1.

Table 1

Yields of grain (cwt per acre) from consecutive wheat crops in trials, Boxworth E.H.F. 1966–68

1st crop	*2nd crop*	*3rd crop*	*4th crop*
40·8	37·3	35·2	33·3

Mean yields conceal the considerable variation that can occur from year to year as shown in Table 2.

Table 2

Loss of yield compared with 1st crop after break—cwt per acre, Boxworth E.H.F. 1965–68

	2nd crop	*3rd crop*	*4th crop*	*5th crop*	*6th crop*
1965	0·2	6·7			
1966	5·5	7·4	8·1		
1967	1·5	5·1	7·9	7·2	
1968 (wet year)	3·6	4·3	5·9	8·4	8·0

The yields and responses given above were obtained at the optimum nitrogen rates, i.e., any limitation of yield due to under or overdosing with nitrogen has been removed. After the third wheat crop most people give up, perhaps wisely, as the worst crop is usually the fourth or fifth. However, in company with a few others, some E.H.F.s have soldiered on into the unknown. The trial at Boxworth is continuing, but information is also available from the

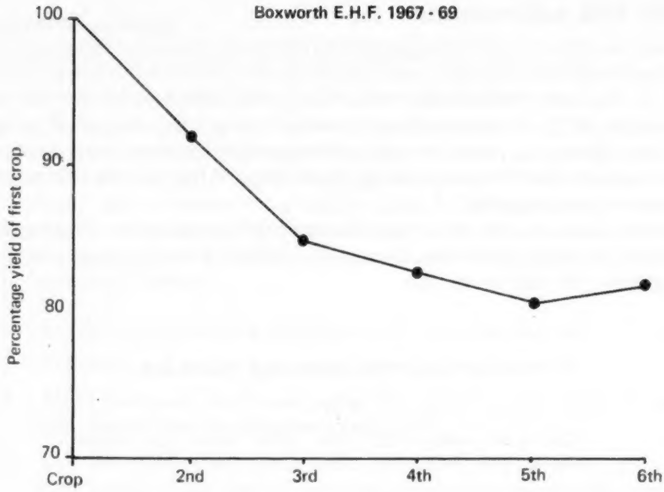


Fig. 1. Decline trend in successive crops expressed as percentage of first crop

small areas under continuous wheat already mentioned. On several E.H.F.s yields on these areas have started to improve, in relation to farm yields, after the fourth or fifth consecutive crop (see Table 3).

Table 3

Yields of continuous wheat as a percentage of average farm yield, 1963 or 1964—1970

Crop	*Bridget's**	*Boxworth*	*Drayton*	*High Mowthorpe*	*Mean*
1st	100	NA	109	103	(104)
2nd	98	103	76	95	93
3rd	91	73	105	101	93
4th	70	68	86	73	74
5th	87	73	79	73	78
6th	91	90	100	89	93
7th	93	92†	115	76	94
8th	—	95	111	94	(100)
Mean	90	85 (no first crop included)	98	88	

*(at optimum N on trial within site) †spring wheat

At Boxworth in 1969 there was an involuntary change to spring wheat for the seventh crop due to the atrocious weather prevailing in the winter of 1968–69. This crop was followed by one which yielded over 2 tons per acre in the glorious summer of 1970.

Sykes' field achievements

It may be fortuitous that this good crop of winter wheat also followed a crop of spring wheat as on another small area of 6 acres at Boxworth known as Sykes' Field. In the early 1950s winter wheat was grown continuously for five years (with yields of 25-35 cwt per acre) in order to study the control of eyespot. Wild oats became a problem and in that pre-herbicide era were controlled in three consecutive late-sown spring wheat crops. After this the field reverted to winter wheat cropping.

Recent yields on this field have averaged 35 cwt per acre (ranging from 26-38 cwt per acre) achieved at the expense of high nitrogen usage and spraying against wild oats every year.

Table 4

Yields at Sykes' Field as percentage of farm crop

Crop								
12th	13th	14th	15th	16th	17th	18th	19th	Mean
103	97	86	90	93	90	100	81	93

Grass weeds

Grass weeds have been encountered on all sites; for example, at Boxworth where 7 acres of wheat have been grown continuously since 1963. Here the drop in yield by the fourth crop was greater than in the trial (Table 3); this feature was almost certainly a reflection of a weedy start, since the first intake into the trial suffered a rather similar fate with yields little over 30 cwt per acre in the second and third crops. Blackgrass became a problem rather more quickly on this area and was not at first adequately controlled. There is no doubt that land should be free of grass weeds at the start if an attempt to grow continuous winter cereals is to be made, because they are a frequent cause for the abandonment of such sequences.

Soils and soil borne diseases

It is significant that yields declined fastest at Rosemaund where the soil is a stoneless silty clay loam of rather weak structure. By comparison, the clays at Boxworth and Drayton and the soils over chalk at Bridget's and High Mowthorpe are stable.

At Boxworth, soil borne diseases have not apparently had a major consistent influence upon the yield of continuous wheat. Take-all, though frequently present, is generally found only in a mild form. The presence of a factor antagonistic to take-all has been found on Sykes' Field and some of the current work is investigating wheat grown after continuous barley to see if the same situation exists or can be created. In contrast, at Rosemaund E.H.F. a level of 70 per cent severe take-all has been recorded in the low yielding third wheat crops.

It is possible that the effect of the disease at Boxworth has been minimized by making firm seedbeds and by early applications of nitrogen in the spring. But a more likely reason is the fact that the soil there is inherently well structured and capable of mole-drainage at regular intervals. Current philosophy on take-all is that it is usually a symptom of other basic deficiencies.

Boxworth method

Relative success at Boxworth largely follows two basic tenets:

A clean start is essential and *Nothing succeeds like success.*

A good crop provides a good starting point for the next. It returns enough organic matter to maintain the level in the soil, albeit at a rather low level (2·6 per cent 0–6 inches). It exerts a strong competitive effect on grass weeds and reduces their reproductive capacity. Only in bad seasons are less than average yields acceptable if winter wheat monocultures are to succeed. Apart from these general points a number of rules for growing continuous wheat on heavy land are followed:

1. Ensure a good stubble burn and mole drain at intervals.
2. Plough or use heavy cultivator immediately afterwards.
3. Allow adequate weathering after the primary cultivation to enable easy production of a kind seedbed.
4. Kill volunteer wheat plants, blackgrass and autumn germinating wild oats (both *Avena Ludoviciana* and *Avena Fatua*) and blackgrass by cultivations or paraquat if necessary. See also rule 11.
5. Produce a firm seedbed (Sykes' Field has a tendency to be 'hollow').
6. Achieve timely drilling. In the pre-blackgrass herbicide era this was restricted to after 5th November. Timeliness = opportune use of good conditions.
7. Use an eyespot resistant variety at normal seedrate. Use 1½ cwt superphosphate per acre or 1½ cwt 12:24:0 compound if drilling after mid-November.
8. Apply part, probably half, of the spring nitrogen top dressing as early as possible in the spring—usually early March. If forced to choose a single date apply all nitrogen early to continuous winter wheat as experimental evidence supports this.
9. Use 100 units of nitrogen in the spring. Add 20 units more after a wet winter.
10. Roll early as this seems particularly beneficial.
11. Control wild oats and blackgrass. If tri-allate has not been used in the autumn a wild oat herbicide in the spring will be required. This may be in addition to a single purpose blackgrass herbicide in the autumn or indeed the use of a dual purpose autumn herbicide.
12. Do not relax. New troubles can occur quite rapidly; for example, couch, spring germinating blackgrass, etc.

Future developments

Good drainage permits timely cultivations which in turn help with the battle against grass weeds and help stave off take-all.

With the advent of superior blackgrass herbicides and dual purpose wild oat/blackgrass herbicides it may in future be possible to adopt a system of reduced primary cultivations and thus, because of a lesser degree of clod formation, go for earlier autumn sowing. This would overcome what is at

present a stumbling block in the path of continuous winter wheat growing—the short time available for cultivations between one crop and the next. This timing factor and the grass weed problem have limited the growing of continuous wheat on any scale.

To sum up, continuous wheat growing is just as challenging as more traditional farming but leaves no leeway at all for sloppy husbandry. It is feasible on a number of soils but has attendant difficulties and one must be alert to the problems, although new techniques coming forward will make the job easier. At present the system would appear to suit only relatively small acreages or the odd field here and there. Should future prices favour wheat rather than barley, winter wheat monocultures would become more financially viable.

Wheat based rotational farming has usually been rather more profitable on heavy land, and is certainly safer. However, much depends on the cash output of the break crops themselves; the financial advantages of break crop rotations have recently tended to shrink. The possibility of winter wheat/spring barley sequences is under investigation.

MILK BOTTLE CAPS

Proposals for Statutory Colour Code

A quick and easy way for the housewife to recognize the various types of milk on sale is set out in proposals for a statutory colour code for milk bottle caps recently sent by the Ministry of Agriculture, Fisheries and Food to interested organizations for comment.

A voluntary colour code for milk bottle caps was introduced by the trade in 1967 but this has not been observed by all dairymen. As a result milk of the same type has been sold in different parts of the country with different coloured caps. This has led to confusion, and people have not always been sure exactly what type of milk they were getting for their money.

The new proposals will in due course result in legislation specifying which cap colours must be used for the various types of milk sold in England and Wales. In general, the colours proposed are the same as those already in most common use: silver for ordinary pasteurized milk; red for pasteurized homogenized milk; gold for pasteurized Channel Islands or South Devon milk. In addition, a further colour—green—is proposed for untreated milk. The regulations will be enforced by local food and drugs authorities. Sterilized milk is already easily recognized by the special bottle and the crown cork, and ultra-heat-treated milk, which is advertised for its long-keeping qualities, is usually sold in cartons.

Under the Milk (Special Designation) Regulations nearly all milk sold by retail for human consumption must be specially designated as untreated, pasteurized, sterilized or ultra-heat-treated. Untreated milk has not been subjected to any kind of heat treatment. The other types of milk have been processed at varying combinations of time and temperature, and these processes are laid down in regulations in order to ensure that they are fully effective and that the public health is protected. Homogenized milk is pasteurized milk in which a further process has evenly distributed the milk fat globules so that there is no cream line.

Existing legislation already requires containers in which milk is offered for sale to be conspicuously and legibly labelled with the appropriate special designation, but most people seem to pay more attention to the colour of the milk bottle cap. Once the new regulations are made, a cap of one colour will always indicate the same type of milk, and the housewife will be able to tell at a glance that she is getting what she has ordered.

Machinery

Slew-loader loading flail cut clamp silage into self-unloading forage box

This feature, on aspects of agricultural machinery, contains articles by:

★ **J. B. Finney, B.Sc.(Agric.), Dip. Agric. (Reading), N.D.Agr.E.,** is a Mechanization Adviser with A.D.A.S. at Cambridge.

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Mechanized Feeding of Silage

W. R. Catt

ON a national basis, silage at present provides 15–20 per cent of the winter feeding requirements of our cattle, but improvements in grassland management and the tendency towards larger parlour milked and loose housed dairy herds seem likely to increase the importance of silage as a winter feed in the future.

Past criticisms of silage have labelled it a heavy, wet material with an unpleasant odour. Wilting and careful sealing virtually eliminate the last criticisms, but the product still remains one-and-a-half to four times as heavy as the equivalent amount of hay. However, with developments in mechanization, sealed bunker or tower silage can now be moved mechanically at all stages and outloading and feeding need no longer be the back-breaking chore that it was ten years ago.

Bunker silage

When considering the feeding of bunker or clamp silage, self-feeding automatically springs to mind as the well-tried and simple system. It is, therefore, worthwhile listing some of the more important advantages of mechanized feeding:

1. Silage can be stored at a greater depth than the 5–7 feet commonly used for self feeding, which means that bunker width need not be related to stock numbers and less floor area is required.
2. Lessening the width and increasing the height reduces the surface area to be sealed, thus reducing potential wastage. Self consolidation of forage is greater with increasing height, which assists air exclusion from the mass.
3. Silage can be rationed out with reasonable accuracy. This may be a debatable point, but certainly mechanized feeding can provide for the addition of cereals or other foods to the silage ration. Young cattle in the 18–24 months age group will not experience trouble in obtaining and consuming the necessary quantities.
4. The slurry scraping chore is a simple one of daily attention to the hard standing adjacent to the feed manger.
5. The silo need not be near the cattle sheds, which means that cattle and vehicles do not impede one another during silage making. Planning for future expansion is easier and several groups of animals can be fed from one silo.

BUNKER OUTLOADING MACHINERY

The machines generally used for outloading bunker silage are the foreloader or rearloader fitted with buckrake, fork or grab, and the slew loader fitted with grab. There are also special purpose-built unloaders.

When using the foreloader or rearloader on flail-cut or double-chop forage, cutting the silage across the working face with a motorized silage knife, or chain-saw with the correct chain fitted, generally helps removal. The loader fork with its tines held horizontally by a parallel linkage or hydraulic ram can then be used to pick up the blocks of silage and transfer them to the feed manger directly or by means of a transport vehicle. Metered-chop (full-chop) silage does not require pre-cutting.

The foreloader mounted silage grab, hydraulically operated, obviates the need for pre-cutting flail or double-chop materials, extracting them and full chop silage straight out of the bunker. A slew loader with a suitable grab can achieve the same results as the grab on the foreloader, but with less wear and tear on the operating tractor.

When using any of these outloading methods and particularly with high-dry matter silage, every effort should be made to minimize the entry of air and secondary fermentation between successive unloading periods. This can be helped by keeping the cross sectional area of the bunker to a practical minimum by avoiding over-wilting (at most 27–30 per cent dry matter), by short chopping with a full chop harvester and by ensiling to a settled depth of at least 10 feet. After unloading, the working surface should be left as smooth and even as possible and, if practicable, covered with a polythene sheet, this being particularly worthwhile if the bunker is unroofed and exposed to the elements.

At present the only purpose-built bunker silo unloaders commercially available in this country are imported machines. They are tractor-powered with auger, chain and flight or multi-knived cutting heads which swing in a vertical plane and feed the silage into a blower or conveyor which can load a trailer or forage box. As with the tower silo unloaders first imported into this country, performance of these bunker unloaders is unlikely to be as good when handling grass silage as when handling ensiled lucerne, maize or whole crop barley. However, development work is progressing on new types of unloaders to handle long flail-cut grass at acceptably high output rates.

FEEDING MACHINERY FOR BUNKER SILAGE

Some of the more important points to consider when choosing the method of delivery of the silage to the stock are:

the total quantity of silage to be handled per annum and the capital expenditure likely to be justified;

the type of material, particularly in terms of chop length and unloading method;

the form of feed manger to be used;

the possible need to mix in and feed a cereal ration with the silage and the degree of rationing accuracy required;

the availability of tractors and men at feeding time;

the space available for manoeuvring vehicles and the distance between silo and feed manger.

The machinery required for feeding can range from a simple buck-rake or foreloader fork to forage boxes or sophisticated mechanical feeders fixed above the feed manger.

Loader mounted fork. With a tractor and driver present at feeding times the loader mounted fork can provide a low cost method of placing all types of silage behind a feed barrier to which there is suitable access; travelling distances must be kept short and spillage in transit can be a problem.

Moving floor or tipping trailer. The moving floor sometimes available as part of a manure spreader conversion is more expensive, but does not require the tipped height clearance of an ordinary trailer and gives a more even and controlled spread of silage along the passageway. Where a double sided barrier is used to form a passageway for the trailer, little if any hand forking should be necessary, provided that the width allowed for the trailer is not excessive.

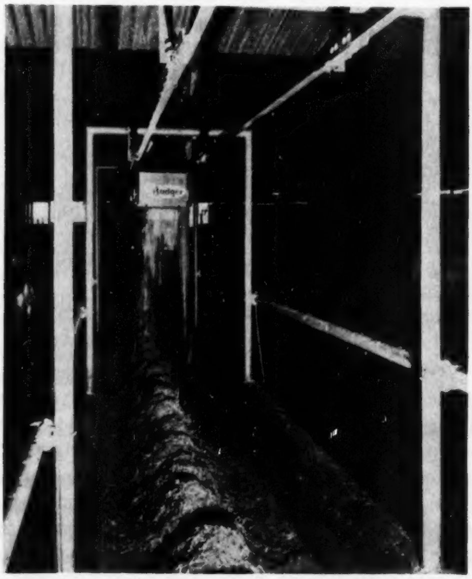
Self feed trailers. These have a lot to commend them as a low cost means of providing both the transport vehicle and the feed manger. Some models contain the silage in a high level rack which is V-shaped in section and similar in principle to the old wooden hay rack. Others take the shape of a low loading trailer with the top of the sides and ends made up of vertical or sloping bars spaced at the correct intervals to form a feed barrier through which the cattle put their necks. 'On farm' conversion of existing trailers (both 2 and 4-wheeled) can often provide an economic transport and feeding unit.

Modified manure spreader feeding flail cut silage to breeding ewes

Self-unloading forage boxes. Many currently available self-unloading boxes were designed to handle high-dry matter, full-chop (metered-chop) silage which will not wrap around shafts and over-tax chain traces and bearings in the same way as long unwilted material. If flail-cut or double-chop silage is to be handled, particularly after being outloaded in large unteased chunks, then the manufacturer should be consulted on the suitability and likely reliability of his box for the purpose. The feed manger must be designed to match the clearance, discharge height and horizontal throw of the cross conveyor on the chosen forage box. Sufficient side and overhead clearance must be provided in feeding passages and doorways, and room must be left for the necessary turning radius, particularly if the forage box is of the

4-wheeled type which cannot be easily reversed.

Permanently installed feeders. Some of the permanent feeders now being used to handle tower silage should certainly be capable of dealing also with suitably prepared clamp silage. The main considerations are likely to be length of chop, freedom from heavy unteased lumps, and evenness of loading on to the feeder. Chop length is dependent on choice of forage harvester and even feed provided by the use of a purpose-built feed hopper or dump box. At the time of writing permanently installed feeders are relatively untried, but they could fit in well with some of the clamp silo unloaders at present being developed.



Chain and slat shuttle type feeder distributing metered-chop tower silage along double sided manger

Tower silage

Over the past few years the considerable revival of interest in tower made silage has been due in no small measure to the fact that unloading and feeding can be completely mechanized.

Unloaders are basically of two types, top unloaders and bottom unloaders. Depending on the circumstances, each has its advantages and disadvantages which should be examined in relation to general management, operation and maintenance of the installation being planned. The top unloaders currently available are fan and single auger, fan and double auger, double auger and central flue to bottom conveyor, chain and cutters with internal side shute, chain and cutters with vertical auger and discharge conveyor. Bottom unloaders are of two types, a rotating arm with chain and cutters, and a swinging arm with chain and cutters.

The performance of all these machines can be enhanced by ensuring that

the crop is correctly wilted, consistently chopped to the correct length and evenly spread in the tower.

FEEDING MACHINERY FOR TOWER SILAGE

Methods of feeding precision chopped tower silage can include the use of self-feeding trailers, tipping or moving-floor trailers, self-unloading forage boxes, self-feed hoppers/mangers and permanently installed feeders. The comments about self-feed, tipping and moving-floor trailers made earlier when considering feeding bunker silage apply equally to the feeding of tower silage.

Self unloading forage boxes. The main advantages of the self-unloading forage box are that two or three such vehicles may already be available for tower filling operations; this offers a good insurance against breakdowns. Timing of the feeding operation and the actual rate of feed discharge along the manger are not tied to unloader performance. The forage towers can be sited conveniently away from the livestock buildings. Other feeds can be mixed and delivered along with the silage.

Self-feed hopper/manger. The use of self-feed hoppers or mangers is a relatively new innovation; an overhead conveyor with drop-off points fills up a series of *ad lib.* feed hoppers. As an alternative to a long single run of manger this system allows small groups of cows to move freely from adjacent cubicle housing to the feeding area without any need for half of the animals to trek around the ends of a single long manger. The main disadvantages are likely to be the practical difficulty of slurry scrapping from around the mangers and the higher initial capital cost per cow space.

Permanently installed feeders. Advantages of the permanently installed feeder are that the labour requirements are minimized; automatic control is possible; feeding times are not tied to the presence of tractors and drivers; space requirement is low with a double sided manger because feeding passageways are not required and fairly precise rationing can be applied. The last ten years has seen a gradual swing away from the auger types to those employing either chain and slat or rubber belt conveying and distribution mechanisms. These latest feeders have ousted the auger because they have a lower power requirement, suffer less wear and tear, are quieter in operation and give better distribution of the silage and other materials.

Mastitis and the Dairy Farmer

'Mastitis and the dairy farmer' is the theme of the second National Agricultural Centre Dairy Conference, to be held on Wednesday, 6th October 1971 in conjunction with the Agrochemical Division of CIBA-GEIGY (UK) Limited. The conference, which is designed to highlight the scale of the mastitis problem and to cover its control in Britain, will appeal to all with an interest in dairy farming.

The morning session will include papers on mastitis as a disease, two case studies from dairy farmers and methods of prevention. During the afternoon delegates will visit the N.A.C. Dairy Unit and there will be illustrated talks on parlour routine and hygiene, milking machine testing, and cell counting and mastitis predictions. The conference will close with a report on the latest developments in mastitis control in the U.S.A.

Programmes and application forms can be obtained from the Secretary, National Agricultural Centre, Kenilworth, Warwickshire, CV8 2LG.

Mechanization and Soil Structure

J. B. Finney

It has often been claimed that British agriculture is the most highly mechanized in the world in terms of 'tons of machinery to the acre'. In recent years considerable concern has been expressed about the effect that this machinery may be having on the soil, and this has led, in part, to the Agricultural Advisory Council report *Modern Farming and the Soil** published in 1970. Soil damage by traffic is closely connected with moisture conditions, and it is worth noting that recent concern with the problem built up over a series of wet autumns. Jethro Tull, writing in 1762, mentioned the compacting effect of repeated horse traffic, especially under moist conditions, and it can be reasonably assumed that compacted fields and various forms of panning have been known over many generations and generally connected with wet conditions. What is of special interest today is the extent to which modern machinery has changed the situation.

Tractor engine size has increased steadily over many years, and also, until recently, have tractor numbers, so that total power available has increased rapidly. Most tractor power is transmitted to the implement through the tyres, weight being required to get the necessary traction. Tractor weight, therefore, rises with power. It has been shown by survey work that large tractors may prove to be an economically sound proposition through increased output per day from one driver, or through improved timing of operations. It has also been shown that the larger tractors are more difficult to load fully—in fact an impossibility with some low draught implements—and, therefore, spend more of their time operating at part load but carrying weight proportional to their full power.

Ground pressure

Tractor weight increases with engine power and so, generally, does tyre size. Ground pressure under the comparatively low air pressure tractor driving wheels depends very much on inflation pressure and, therefore, can be very similar under a range of tractor sizes. The effect of a heavy tractor at a given average pressure under the tyre is, however, felt to a greater depth in the soil than that of a light tractor. Pressure on the soil is quoted as an average figure because the distribution is not uniform and depends on the height and size of the tyre lugs, the stiffness of the tyre carcase and the state of the soil. For a given width of tyre and soil situation the compacting effect on the soil is dependent on the pressure applied, which suggests there is some value in using the lower pressure tyres. What is of more importance is the

*Obtainable from H.M. Stationery Office, price £2·10 [£2·16½ by post]

strength of the soil, and this depends largely on its moisture content and its initial state of cultivation. The following example has been quoted for the effect of moisture on a heavy soil. To compact the soil to a given degree, the surface pressure applied was 285 lb per square inch when dry, 48 lb at 14 per cent moisture and 5·6 lb when wet.

The shape of the tyre contact area has some effect and under soft soil conditions sinkage is likely to be slightly less with a large tractor at a given ground pressure because of the shape of the contact area. This is not likely to be of any practical importance with the alternative tyre sizes available for ordinary farm tractors.

Wheelslip

A tractor has to be involved in some wheelslip in order to produce the draught required to pull an implement. The range for a tractor ploughing with a correctly matched implement under good conditions is normally of the order of 12–15 per cent; 30 per cent is commonly exceeded under more difficult conditions, and it is not obvious to the eye much below 20 per cent. The soil is therefore subjected to a vertical force from the load on the tractor axle, a horizontal force from the draught developed, and puddling and smearing from the slipping tractor tyre. The effect of smearing of furrow bottoms is well known, and little progress has been made in ploughing with wheeled tractors up on the land to avoid this damage. The real danger of smearing damage lies in the efficiency of this action in locally ruining soil structure. Slip is greater with increased draught and less with increased weight; to reduce it the choice is either to increase the weight of the tractor or to reduce the width of the implement. In the former case, the load on the soil becomes greater, in the latter a greater area of the field is wheel-marked. Very little research has been done on this but the indications are that it is important to reduce slip to the practical minimum, even if extra ballasting is necessary.

Wheelings and speed

Under most field conditions as much as 90 per cent of the total compaction is caused by the first wheeling, with repeated coverage adding virtually nothing beyond three or four times over. This point is important, since with traditional work in many crops up to 90 per cent of the total area may be rolled by a tractor wheel. A few farmers on sensitive soils are now setting out beds after the primary cultivation and carrying out the rest of the work for that crop on the original wheel marks.

There is very little evidence available on the effect of speed of tractor operation on soil damage. What there is suggests that within the practical speed limits for a tractor the forward speed will have no effect. It is known that speed of rolling with an ordinary agricultural roller has a considerable effect on the result, but this is with a very much smaller diameter and a very much lighter rolling action than a tractor tyre.

Effect of soil moisture content

The moisture content of the soil is the most important single factor in compaction by machinery. Dry soil is not easily compacted. As moisture content increases, soil becomes more easily compacted up to a certain point.

Above that, the compaction resulting from a given force declines because the larger pores fill with water. The optimum moisture content for compaction is generally at or around the moisture content considered ideal for ploughing. This does not suggest, however, that ploughing at even higher moistures is a better proposition because the physical strength of the soil declines with increasing moisture content. Soil strength is used to provide traction through the tyre lugs, so that the wetter and weaker the soil the greater the wheelslip and puddling and smearing damage. Sinkage is also greater in wet soils, leading to ruts which are a problem for later work, to increased rolling resistance requiring greater power to move the tractor, and again to increased slip and smear.

Ploughing with tractor up on the land: experimental equipment at the National Institute of Agricultural Engineering

The practical problem

Compaction, then, is most likely to occur when soils are wet or loose and when heavy loads are applied. Avoiding wet soils in the autumn may, in many cases, be an economic problem of having enough power and labour available to complete the work before soils are too wet. In exceptionally wet seasons this may simply not be possible because that point will have been reached by the end of harvest. Where soils liable to damage have to be worked, four-wheel drive tractors can be an advantage because of their lower slip for a given draught; and crawlers, because of their low ground pressure, low slip and ability to plough on the land rather than in the furrow bottom are a considerable asset. Only the very largest wheeled tractors are commercially equipped for ploughing on the land, although attempts have been made through the years to arrange ordinary sized wheeled tractors with offset ploughs for this purpose. Even with four-wheel drive this has not proved very satisfactory because of steering problems, but it is likely that present

research work aimed at automatic steering will make it viable. Ploughing on the land would remove smearing of the furrow bottom by the tyre and allow the surface damage to be broken by the following plough.

Much root harvesting machinery is operated under conditions that must lead to soil damage. Total machine weight may exceed that of ordinary farm tractors; tyre pressure and therefore ground pressure is high, and the date of harvest is fixed generally by market rather than by soil requirements.

For spring work it is possible to reduce damage by using cage wheels and half-tracks. Cage wheels of the same diameter as the wheel can reduce ground pressures considerably, and half-tracks bring down average pressures to crawler level and give improved traction. Double wheels, large tyres at reduced pressures, and reduction of ballast can also usefully reduce soil damage. The reduction of air pressure in tyres gives lower ground pressures, but great care should be taken to avoid tyre damage by under-inflation. Finally, the reduction of ballast is an advantage only so long as it does not lead to excessive slip.

Compacting implements

Soil working implements can generally be classified as tending to lift the soil, to be neutral in action, or tending to compact. The first group includes all harrows with the tines inclined forwards, such as spring-tined cultivators and many chisel ploughs. They lift the soil, may bring clods or even subsoil to the surface, and are not compactors. In the neutral range are harrows with vertical tines which do not bring soil to the surface but at the same time do not apply any appreciable downward force to the soil. Any compacting they do is by re-arrangement of the soil particles. The final group includes harrows with backward facing tines, disc harrows and rolls. All are valuable implements because they tend to trap and break clods with their downward action, but they are potential compactors, especially discs. The action of each implement is more pronounced if it is powered (as with reciprocating harrows) or if the soil is wet.

The credit side

There are considerable advantages in having ample power available for cultivation, and it is certain that the standards of crop production common today, particularly in intensive arable systems, could not be achieved without modern equipment. Implements operated by the power take-off play a large part in clod reduction, in the preparation of potato land and in once-over and minimal cultivation techniques. Subsoiling of compacted land in dry seasons is routine practice on many farms and depends on the availability of enough power. Accurate timing of field work, especially where labour is scarce, depends heavily on large scale equipment and high work rates.

The major factors leading to traffic damage to soil structure are soil moisture content, which depends very much on the date of operation (which in turn may be determined by the crop), and the state of the soil itself with regard to its previous history and, especially, to its organic matter content. The future of machinery and its effect on soil structure may depend on changes of cropping system and possibly on reducing to a minimum the amount of work done on the soil in order to grow the crop. There could then be less traffic, and less cultivations later to remove the effect of the traffic on the soil.

Many factors need consideration in the preparation of an efficient, economical

Underdrainage Design

C. A. Brown

SOUND design is essential for efficient and economical underdrainage. This article describes the points to be considered in the preparation of a suitable scheme.

'Drains pull water.' How often is this statement heard—yet, unfortunately, it is quite untrue. In fact, many farmers could hardly be blamed for believing the opposite to be the case when they see water standing on the surface of the field with an underdrainage system lying just below. The fact is that the only force influencing the movement of this water is that of gravity and the principle behind field drainage design is to create a situation in which this force can best exert its influence. For example, the water must be able to move freely from the surface through the soil to the drain and then to easily enter the drain. The pipe itself should be capable of transporting the water unimpeded to where it can discharge freely. Each of these conditions is critical and a weakness at any point in the chain can result in the failure of the system to do its job. With these points in mind, the stages to be considered in the design of an underdrainage system are:

- Field investigation
- Design principles
- Drain depth and spacing
- System layout
- Pipe size

Field investigation

Before thought can be given to the factors involved in the design of an efficient underdrainage system, it is essential to determine precisely what is causing the drainage problem. For example, it may appear on the surface to be simply a spring outbreak, but as the underlying geological pattern which results in the spring may be complex only a careful investigation will enable an effective solution to be found. This point is illustrated at Fig. 1 where just two of many spring situations are shown. On the other hand, the

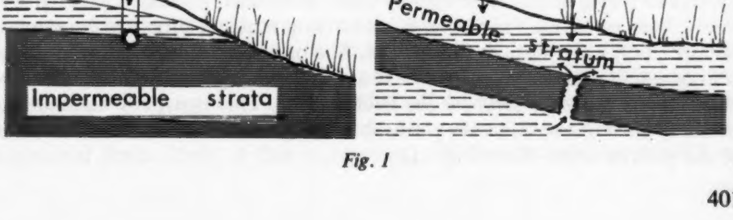


Fig. 1

problem may seem to be one of surface water unable to drain through the soil and yet close investigation reveals a high ground water level—two very different types of drainage problems which demand that quite different principles be applied to their solution. There are many causes of drainage problems, each with its appropriate remedy, and only by a thorough investigation of the field surface, topography, the condition and nature of the subsoil and so on can a satisfactory solution be found.

Design principles

Having determined the nature and cause of the poor drainage, the next consideration is to decide which principle should be adopted for its improvement. The factors influencing drainage conditions can vary considerably from field to field as do the problems and their remedies. However, the main characteristics have much in common and can conveniently be considered under four main groups.

Permeable soils with a rising water table usually in low-lying flat sites. The remedy in these situations lies in controlling the ground water at a level where it cannot restrict the root system of the crop. This can be achieved by a system of deep, regularly spaced drains and because of the natural porosity of the soil permeable fill over the pipes is seldom required (Fig. 2A). It is important in these cases to ensure that the ditches surrounding the field are deep enough to prevent ground water flowing in from neighbouring land.

Heavy clay soils where surface water problems arise due to poor permeability. The principle to be applied is one of improving permeability artificially by shattering and fissuring so that water can pass from the surface down to a system of underdrainage. This can usually be achieved by mole drains drawn when the subsoil is moist and plastic and the field surface is dry. The moles should be at a minimum depth of 21 in. and not more than 9 ft apart over a system of widely-spaced pipe drains. Permeable filling over the pipes is essential to provide a permanent connection between the mole channels and the pipe. The fill also enables the moling to be repeated when necessary (Fig. 2B).

Soils with layers of low permeability or with natural or cultivation pans. These conditions often result in top water ponding and poor crop growth due to restricted root development. Treatment depends upon the circumstances, for if there is a suitable existing underdrainage system or if the soil below the obstructive layer is permeable, then subsoiling carried out under the right conditions may be all that is necessary to deal with the compacted layer. Subsoiling can also be used to advantage on soils of low permeability where, to be effective, underdrains alone would need to be laid at very close intervals. The increased permeability resulting from the subsoiling allows the drains to be laid at wider spacing with a consequent saving in cost (Fig. 2C).

Springs or spring lines. These usually occur at isolated points on sloping sites where, because of the formation of underlying rocks of differing porosity or permeability, water rises to the surface. The principle of design in these cases is to intercept and collect the water at a point and depth at which it is unable to harm the crops or saturate the field surface. This is usually achieved by carefully sited drains laid with permeable filling to ensure the full interception of the ground water flow (Fig. 2D).

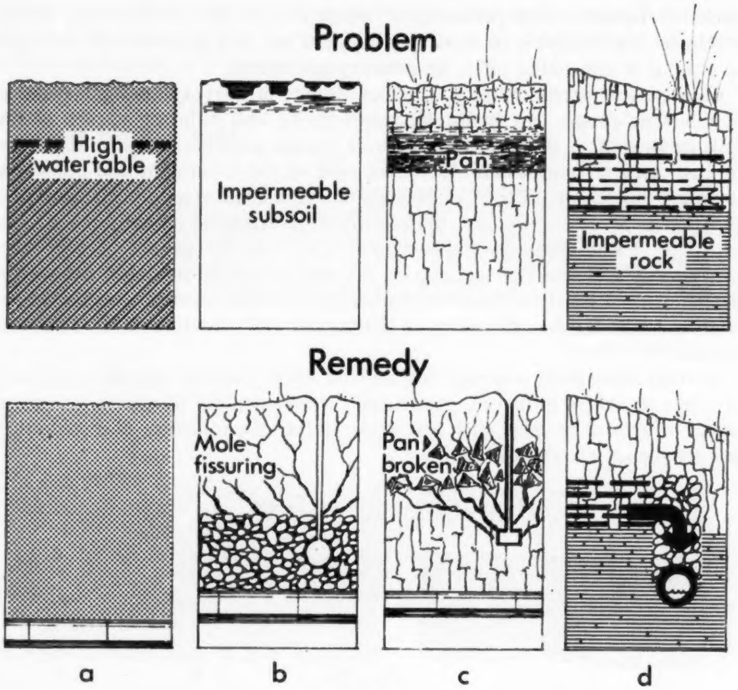


Fig. 2

Drain depths and spacing

As already mentioned, the ultimate objective in installing any under-drainage system is to control the level of the ground water at a depth where it does not adversely affect the plant roots or create surface problems. A water table held down at 2–3 ft below the ground level is normally satisfactory for this purpose. Theoretically the deeper the drains, the wider apart they can be laid. This is true whether applied to free-draining soils or to heavy clays which need to be mole-drained. However, in practice, limitations arise because the free-draining soils are more often found in areas where the depths at which pipes can be laid are controlled by water levels in ditches and rivers. In heavy clay areas pipe and more especially mole-drain depths are subject to limitations imposed by available machine power. Nevertheless, since the permeability of the soil is the prime factor influencing the depth and spacing of the drains, this rule does have a practical application within the limitations described.

A further consideration is that to enable water to move through the soil to the drain the water table must be able to develop a hydraulic gradient. Because of increased friction between the soil particles this will be steeper in soils of low permeability than those more open soils where the water can move freely. These principles are illustrated at Fig. 3 where drains (a) and (c) are too widely spaced to control the water table at a satisfactory depth and so drain (b) becomes necessary. In the case of high permeability soil, additional drain depth, if this is possible, will also provide the control re-

quired. With soil of low permeability, where extra depth or additional drains would be impracticable or too expensive, the use of a permeability aid such as moling or subsoiling offers an effective alternative.

Clearly, soil permeability is a critical factor in drainage design. Because of the wide range, low hydraulic conductivity and differing nature of the soils in Britain, it is rarely economic or indeed possible to apply the more sophisticated techniques and formulae used on the Continent and elsewhere to assess this factor. In this country we rely to a large extent on the skill and experience of our designers, backed by a programme of research at the M.A.F.F. Field Drainage Experimental Unit into all aspects of soil/water relationship and drainage techniques. A system is also being developed within the Ministry based upon the performance of successful underdrainage schemes relating drain depth and spacing to the texture and structure development of the soil.

Further refinement in design will depend upon research into the sensitivity of crops to excess moisture, particularly short-term waterlogging at critical stages of growth coupled with investigation into the influence of distribution and frequency of rainfall.

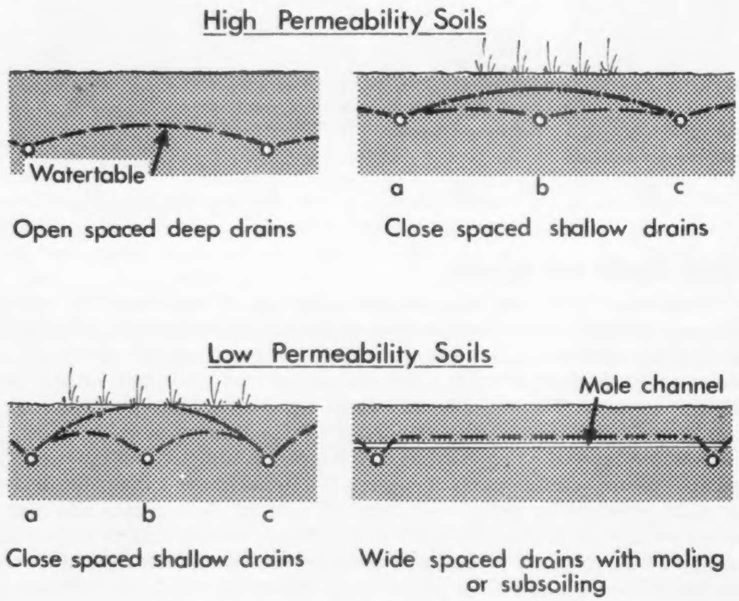


Fig. 3

Reference has already been made to factors which influence drainage depth and the limitations which are sometimes imposed by the outfall conditions. These factors and principles are illustrated at Fig. 4, which also serves to underline the need for outfall ditches of adequate depth and of sufficient capacity to carry storm flows. A well laid pipe drain system is not harmed by occasional submergence and unless the particular subsoil is liable to structural damage or where water-sensitive and valuable crops justify a high standard of design, the intermittent submergence of the drain system is

acceptable. It cannot be too strongly stressed that mole drains must never be allowed to become inundated as under these conditions they will soon collapse and cease to function.

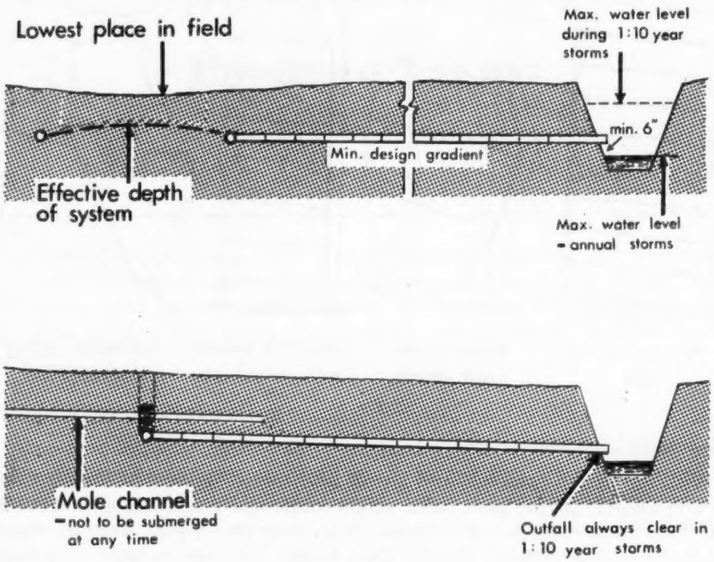


Fig. 4

System layout

Having established the design principle and the depth and spacing of the drains a layout can be planned which will relate these to the topography of the field. The aim is to obtain effective interception of the water consistent with maintaining a reasonable gradient in the pipeline and also in the moles if used. On fields with a reasonable fall this does not present a problem, but on those with very little fall the interception principle is of little significance and can be discarded in favour of a gradient in the pipe by siting the pipeline along the line of maximum fall. A fall in the pipeline is obviously desirable although in very flat areas pipes are sometimes of necessity laid flat.

Steep falls in pipelines and mole channels can result in erosion around the pipe and within the mole channel and should be avoided by siting the drain to lie across rather than down the major ground slope. Critical gradients vary with soil type, pipe size and the volume of water to be dealt with but, as a guide, gradients exceeding about 1 in 20 for normal underdrainage pipelines in erodable soils and 1 in 30 for mole channels may be regarded as steep. When designing the layout a further aim should be to achieve simplicity with a minimum of 'short runs' and junctions; modern drainage machines can then be used to better advantage and the result will be a cheaper and more trouble-free job.

Outlets should be sited so as to reduce as far as possible the length of ditches upon which they are dependent. Their number should also be kept to a minimum except on very flat marsh and fen sites where separate outfalls

for each drain are preferable to make maintenance by rodding or jetting easier. Four examples of typical layouts which take these various factors into account are illustrated in Fig. 5.

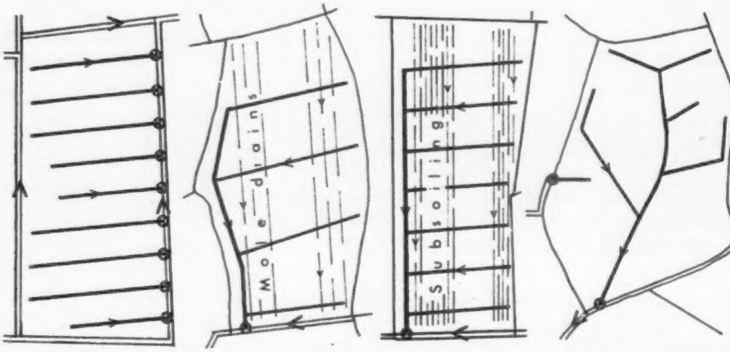


Fig. 5

Pipe size

With the design principle and layout determined the size of the pipes can be considered. In the past, with small fields, short drain lengths and the relatively large diameter of clayware pipes, the size of pipe was not such a critical factor in scheme design. Even today, with the tendency to larger fields, increased drain lengths and a wider range of pipe sizes, pipe size is not as important as the aspects of design already discussed. This is because on the occasions when the pipes are overloaded most soils have the ability to store the water until such time as the pipe regains sufficient capacity.

A number of factors are involved in determining a suitable pipe size, including rainfall, soil permeability and field surface slope. Since they usually have a strong geographical tie, present practice is to use a simple 'Design Drainage Rate' which varies from approximately 1 inch rainfall in 24 hours in upland areas to 0·5 inches or less in low rainfall districts. Other conditions relating the design to the particular site include the area draining to the pipeline and also the fall within the drain itself. The F.D.E.U. has produced comprehensive tables which relate these factors to a wide range of pipe type and size; these will be refined as knowledge increases.

Conclusion

Although drainage work can be expensive its benefits are substantial, and whilst there may be little scope to achieve economies in installation or material costs a scheme based upon sound design ensures that the money is well spent.

Sites vary considerably. Although 'rule of thumb' or 'blanket' designs may do the job there is no substitute for the 'tailor-made' scheme which will certainly be more efficient and usually more economical. In other words, install a system that is designed for your field, not someone else's!

C. A. Brown, A.I.Agr.E., the author of this article, is an A.D.A.S. Divisional Drainage and Water Supplies Officer stationed at headquarters.

Specialization on Pennine Farms

David W. Newell

EACH in his own way, two West Riding farmers have made their enterprises profitable by specializing on different aspects. One, at Spring House Farm, Cawthorne, has concentrated on good management for milk production, the other at New Hall Farm, Stocksbridge, on producing for local market outlets.

Production specialization

A 66-acre Pennine farm situated on coal measures sandstone with small fields and an annual rainfall of about 30 inches does not sound promising material for a farm business. Fortunately, however, this situation is conducive to grass growth and when good yields of quality grass are cashed through productive dairy cows, the picture can change dramatically. This is the position at Spring House Farm, farmed by Mr. J. Nichols.

When Mr. Nichols began farming there about twelve years ago, he concentrated entirely on dairying. His herd has averaged fifty cows over the past year, equivalent to a stocking rate of 1·3 acres per livestock unit. He has never reared any of his own replacements as the whole acreage has been needed by the herd in order to achieve maximum productivity.

The original permanent pastures were rather unproductive and a re-seeding programme was adopted, using grass mixtures of timothy/meadow fescue type. As the livestock stocking rate has intensified, there has been a tendency to re-seed with ryegrass/timothy mixtures which have proved more productive and have resisted poaching better.

Management

The success of Mr. Nichols' farming system depends on a combination of good stockmanship and sound grassland management. High quality grazing in the summer and high quality silage in the winter, with a concentrate ration tailored accordingly, is the secret of exceptional performance figures. To achieve the necessary output from grass, over 200 units of nitrogen fertilizer per acre are used annually. Good, leafy grazing is provided by careful use of the electric fence, and as much grass as possible is conserved as silage to provide about 8 tons per cow for the winter housing period.

The aim is to take as large an acreage as possible for a first-cut in late May or early June and the balance of the silage is made in late July or early August. After wilting, the grass is loaded into the silo as quickly as possible, the first cut operation being completed usually within a week. The silo is sealed immediately with a polythene sheet to minimize waste. Last year

Mr. Nichols used formic acid additive and was impressed with the improved palatability of the silage for the cows and the extra intake achieved.

The cows are milked in a six-stall, three-unit tandem parlour and the milk stored in a bulk tank. During the winter the cows are housed in cubicles and allowed access to self-feed silage. Cubicle housing has meant having to deal with slurry and Mr. Nichols has adopted the principle of keeping and handling it in as solid a form as possible. He has provided an area of concrete for storage surrounded by a reinforced wall about 3 ft high. The concrete area allows 6 sq. yd per cow and provides storage for about a three-month housing period. Opportunity is taken to empty and spread the slurry during periods of frost. Sawdust is used as bedding in the cubicles and some straw is mixed with the slurry to help to bind and contain it.

The concentrate ration, which consists almost entirely of mineralized cereals, is home mixed. Very little protein concentrate is added; with the provision of high quality, well fertilized grass and silage, additional protein is not considered necessary. During the 1970–71 winter the ration consisted of three parts barley, one part dried sugar beet pulp with added minerals, fed overall at 2·8 lb per gallon.

Rewarding returns

For several years Mr. Nichols has participated in the N.A.A.S. Dairy Management Scheme. Results each year reveal a consistent milk yield of over 1,000 gallons per cow, qualifying for quality bonus payments. The annual summary for the year ended March 1971 shows a milk yield of 1,159 gallons per cow, giving milk sales of £212 per cow at a concentrate cost of £34·50. This gives a margin over concentrates of £177·50, which is exceptional by any standards. By concentrating on dairying and applying specialized management and stockmanship, Mr. Nichols has shown how a small acreage farm can be a rewarding and satisfying business.

Marketing specialization

Close to the industrial town of Stocksbridge Mr. Webster farms the 73-acre New Hall Farm. It is situated on the 800 ft contour; the soil type is a light, sandy loam derived from millstone grit and the annual average rainfall is about 38 inches. In this situation Mr. Webster has exploited two inherent advantages; proximity to an urban population giving prospects for retail sales, and climatic conditions conducive to good grass growth throughout the season.

When Mr. Webster began farming on his own in 1958 it contained the traditional range of L-shaped stone buildings with the farmhouse attached. The buildings comprised single range cowsheds and a stone barn. He immediately adopted the mixed farming policy traditional to the area, with a small dairy herd of seventeen cows and crops of cereals, potatoes and roots. In another way he was less traditional; he quickly became market orientated and began retailing milk, selling 10 pints per day direct from the can!

Expansion

The dairy herd has been expanded gradually with replacements provided mainly from home-reared stock. Increased accommodation was provided initially by altering the existing buildings which allowed the number of cows

to be increased to about thirty-five. During this time a retail milk round was being firmly established in Stocksbridge; this also provided a valuable outlet for the sale of eggs and potatoes.

In 1967–68 a major policy decision was made possible only because of the accumulated profits built up from the farming business. In order that the dairy herd might be expanded further, Mr. Webster decided to erect new buildings for self-feed silage and loose housing in cubicles. A six-stall, tandem parlour was installed in an existing single range cowshed and full use was made of existing levels so that bottling could be carried out directly from the bulk tank. The policy is to continue to sell as much milk as possible through the retail outlet, although some now goes to the Milk Marketing Board. The herd has been increased to fifty cows and present facilities will allow for further expansion to fifty-five cows without any additional capital expenditure.

Intensification of stocking has called for concentration on improved grassland management and the abandonment of corn growing. The present stocking rate is 1·3 acres per livestock unit; this is achieved with the use of about 130 units of nitrogen per acre annually, together with the additional nutrient supplied by the farmyard, pig and poultry manure. Seed mixtures based mainly on ryegrass are gradually replacing the more traditional Cockle-Park type of mixture.

The new buildings for the dairy herd have enabled a pig enterprise to be expanded in the old cowsheds. About eleven sows are kept and all progeny are fattened to cutter weight and sold direct to a local butcher at a previously agreed price. There is a poultry enterprise of 800 layers, all eggs being sold either on the milk round or direct to shops.

Measure of success

A measure of the financial success of this farming business is seen in the output achieved. During the past two years the farm output has averaged £365 per week, which is equivalent to an annual output of £260 per acre. Normally, one would assume that a Pennine farm of 73 acres was a small farm bordering, perhaps, dangerously near to that ugly word 'unviable'. It is a salient fact that many farms traditionally regarded as large cannot boast output figures in the same dimension as those being achieved by Mr. Webster, which is a credit to his business acumen. His output is being achieved within a reasonable cost structure. Machinery on the farm, although good, is minimal; only family labour is employed and although the new buildings for the dairy herd were fairly expensive, Mr. Webster being an owner-occupier is able to take maximum advantage of depreciation allowances.

Way to success

These are but two examples of how a farmer can achieve a worthwhile and profitable enterprise from small and seemingly inhospitable beginnings. Success may depend upon many factors, but perhaps above all upon good stockmanship and management and a determination to specialize on what is most advantageous and suitable to local conditions.

D. W. Newell, B.Sc., is a District Agricultural Adviser with A.D.A.S., in the Penistone District of the West Riding of Yorkshire.

'He who whispers down a well
About the goods he has to sell
Will not reap the shining dollars
Like he who climbs a tree and hollers.'

Conservation Matters—So Do Communications

N. A. Aldiss, *A.D.A.S., Oxford*

THE Conservationist, like the industrialist, must advertise if he is to 'sell'. Even in this jet age it is true to say that half of the world does not know how the other half lives. It is also true that many people who are not connected with farming and land ownership do not appreciate that it is the British farmers who have shaped our landscape. On the other hand, farmers busy with their everyday job of making a living from the land may be unaware of the far reaching effect some apparently simple act like filling in an unwanted pond, or clearing away a redundant hedge, can have on the flora and fauna of the locality.

Care of the land

For generations, townsmen and countrymen have regarded one another with a certain amount of suspicion; and now, with modern transport facilities, large numbers of townsmen are able to spend more and more time in the country. Therein lies a danger that both townsmen and countrymen may suffer because of the failure by one to understand the needs and problems of the other. Yet there is still room for townsmen, countrymen and wild life in these islands provided we all exercise the greatest care in the use of the land.

How is this to be brought about? By better communications between all interests and by education at all levels and at all ages. There must be close and continuing contact between all land users, whether they farm it, dig for minerals, store water there, play there or just look at the view! Most of these groups have their own official bodies to care for their needs. Some of them, particularly in the case of the conservation groups, are so close that they appear to overlap, while others are poles apart. The Minister of Agriculture, Fisheries and Food gave a lead when he asked the Agricultural Executive Committees to bring the interested parties together in Agricultural and Environmental Groups to study the mutual problems of conservation and agriculture to establish and maintain effective liaison between the organizations representing the users of our land. Most of the groups are finding that there is a need for education to enable people to study ecology in relation not only to agriculture, but also to recreation and other forms of land use. Good work is already being done in this field by, among others, the Workers Educational Association, the Field Study Council and Local Education Authorities at their Adult Education Centres. It is to be hoped that many more people will take advantage of the facilities provided for them.

Closer co-operation

There are signs that wild life organizations are getting together and talking of mergers. As flora and fauna are so interdependent, it does seem strange that there should be separate groups mainly interested in the protection of a single class of wild life. Closer co-operation of such interests could lead to greater strength when wild life is threatened.

Even where interests might seem to be in natural conflict, there is already quite a lot of co-operation. Farmers and fruit growers are getting together with the conservation bodies to organize farm walks and discussions on mutual problems. The gravel operators and the Central Electricity Generating Board have indicated their concern for wild life by forming nature reserves on their own properties.

One sometimes gets the impression that conferences and exhibitions arranged by the conservation bodies are intended mainly for the benefit of members and that subscriptions are paid to gain entry to a somewhat exclusive club. As a result, the many excellent speakers who address these gatherings appear to be preaching to the 'converted'. One wonders if these dedicated workers would not be spending their time better if they sometimes went not only into the 'highways and byways', but also into the roads and streets of our towns and cities—to try to persuade a few more people to join the ranks of those who are already well aware of the needs of conservation.

Arousing interest

Every weekend during the summer dozens of village flower shows are held. At many of these a 'Conservation Corner' could be staged, with a little co-operation between the conservation groups and the show organizers. Such an exhibit need not be expensive or elaborate; a few bright posters, large coloured photographs and plenty of instructive leaflets are all that is required. The presence of a few live wild creatures would attract the interests of children and their parents. Frogs, lizards, rabbits, mice and other small creatures which used to be so common are almost unknown to many children today. Such an exhibit could be manned by members of the Conservation Societies, some of whom would probably be at the show in any case.

We all have a part to play in the conservation battle. It is up to us to find out how we can help to improve our environment and so avoid its spoilation through our own ignorance or apathy.

Farming Looks Ahead

This month the Agricultural Development and Advisory Service is holding two one-day conferences to consider the major technical problems farmers will have to face in the next ten years. These special conferences will be held on 23rd September at the University of Lancaster and 24th September at the University of York.

Sir Emrys Jones, Director General of A.D.A.S., will open each conference and speak on major technical problems. Speakers will then discuss in greater detail various subjects, including problems of intensive livestock production, future development of cereal growing, drainage and soil structure, improvement of grass, etc. Similar events will be held later on at other centres.

The conferences are open to farmers and others at a fee of £1 each, which includes morning coffee, lunch and copies of all conference papers. Further details may be obtained from the Regional Information Officer, Ministry of Agriculture, Fisheries and Food, Block 2, Government Buildings, Lawnswood Leeds 16.

in brief

- **Conifers at risk**
- **Geese on the side**
- **Pesticides in focus**

Conifers at risk

STANDS of conifers in managed plantations have a serious threat to their timber potential by the fungus *Fomes annosus*. It is, in fact, the greatest disease hazard in British forests, and one against which private landowners in particular should be on their guard. It is responsible for roughly 90 per cent of the decay in conifers in Britain. All species of conifers are at risk to a varying degree, and some damage may indeed also be caused to hardwoods, e.g., young and middle-aged beech, oak and red oak, where they are in a mixed stand with conifers. The focal point of infection is the leathery shelf-like fruiting body, usually to be found at the base of dead or dying trees or on stumps and roots under sheltered conditions. These fructifications, as they are called, produce minute spores that can be carried for long distances by the wind to start new colonies on exposed woody tissue of conifers. Thus the stumps left by thinning or clear felling are ideal new hosts for the germination of the fungus spores, whose developing mycelium thrusts down into the stump, which it gradually decays, so passing infection through its root system to contact and infect neighbouring trees.

More often than not the result is butt-rot, of which no symptoms are visible; sometimes the fungus may be confined to the roots and so cause their decay and death. In its dual role as a saprophyte on conifer stumps, where it can live for decades and thus constitute a threat to newly-planted trees for years, and as a parasite of the living tree, the survival chances of this fungus are heavily weighted in its favour. The most susceptible species are Western hemlock and Western red cedar but larch and spruce are also highly susceptible. Pines are resistant to fomes butt-rot but on sandy alkaline soils and on old arable sites they suffer severe killing attacks.

The Forestry Commission's leaflet (No. 5)* on this subject emphasizes the importance of old stumps as the principal initial sites of infection. Attacked trees may be expected to start dying about 18 months after planting and continue for some years. The disease, gradually radiating from these centres, can inflict severe losses, especially on alkaline soils; moreover, when rot has spread through the roots, windblow will take its toll of the weakened trees. Advice is, therefore, concentrated on eliminating the stump source of infection by brush treating them copiously immediately after felling with a 10 per cent solution of sodium nitrite, which can be obtained commercially with a marker dye already added. In the case of pine only, the stump can be inoculated with a competing fungus.

A word of warning about sodium nitrite is necessary, however, since this chemical is poisonous. Handled with normal and reasonable care, it is quite safe to use but unattended domestic animals should be kept out of treated plantations for at least two weeks, and care should be taken to ensure that it does not contaminate water supplies. Alternative materials are the boron compound marketed under the name of 'Polybor', and the nitrogenous fertilizer urea, either of which may commend itself particularly under the varied conditions of private forestry.

***Forestry Pathology Leaflet No. 5 *Fomes annosus*. Price 15p. (16½p. by post) from H.M. Stationery Office.**

Geese on the side

A long, if tenuous, line of history lies behind the goose—a bird hallowed in folklore over many centuries in successive civilizations throughout the world. Revered before it was domesticated, vestiges of age-old, now largely forgotten superstitions still cling to it; older Celtic people may, for example, still remember the taboo against eating goose flesh, and the still common practice of breaking the wish-bone, subsequently transferred to the turkey and chicken, was originally a custom of divination proper to the goose alone. Its long and traditional association with the feasts at Michaelmas and Martinmas in England belongs to the simpler agricultural economy of the commons, open fields, the fattening stubbles and the convenience to tenants of keeping their landlords in good humour. But now, in the third quarter of the twentieth century, the goose, like Caesar, has fallen so low with few to do it reverence. Signs are not lacking, however, that the goose, new style, prepacked and oven-ready at between 10 and 16 lb, may again soon be competing with turkey at Christmas-time or indeed be re-established in its own special market at summer's end.

The first requirement is the right kind of bird—one which when dressed for the table has a small, compact carcase and much less fat than our forbears found to their taste. Whilst the Embden and Toulouse at the lower end of their weight range (say 14–15 lb) may meet the need, the white-feathered Danish birds making around 10–12 lb at 18 weeks could be a generally better market prospect. The fact that geese, unlike any other of our domestic birds, can be kept on grass for the greater part of their lives must be seen as a major advantage in promoting the profit margin; on reasonably good grass a stocking rate of 15–20 birds to the acre should be possible. Supplementary feeding of grain should normally be unnecessary though, of course, the birds will benefit from it in the last few weeks before killing. Their general management is easy and, apart from safety precautions against foxes at night, no special housing is needed.

Although we are unlikely to see any developments towards large-scale goose production, it would seem that modest ventures in geese as a sideline have possibilities that could be further explored, especially if supported by well-directed publicity aimed at the hotel trade, the growing number of delicatessens and the housewife planning a luxury meal.

Pesticides in focus

THIS is the title of a new colour film produced by Shell which appraises and presents with commendable objectivity the role of pesticides and their environmental side-effects. The formulations and ultimate use of these chemical aids are shown to be the result of a highly responsible scientific attitude, with scrupulous and long-term testing in the laboratory and the field before seeking official approval to the marketing of the product. In a world where growing populations and their means of subsistence are in an inverse ratio and, paradoxically, less and less manpower is contributing to correct the imbalance, the use of pesticides to reduce the toll which would otherwise be taken by the opposing forces of diseases, pests and weed competition must be seen in their true perspective. This half-hour 16 mm film, which can be borrowed free from Shell (Petroleum Films Bureau, 4 Brook Street, London, W1Y 2AY), does just that.

AGRIC

CORRECTION

In the article Land Reclamation on the North Yorkshire Moors published in *Agriculture* July 1971, page 313 contained a statement that 'Copper has had to be injected into the soil regularly . . .'. Would readers please note that this should have read 'Copper has had to be injected into the stock regularly . . .'.

Farming Cameo: Series 4

50. The West Riding of Yorkshire

V. Cory

YORKSHIRE, as every schoolboy knows, is England's largest county. One of its three parts—the West Riding—is a giant in itself sprawling from the Humber almost to Morecambe Bay. Although best known for its coal, electric power, steel and textiles, the area is also proud of its farming. The Yorkshire (Large White) pig, the Dales Bred sheep and the Long horned cattle of Craven originated there; on the arable side, green peas, forced rhubarb and the now extinct liquorice have given the county distinction.

Early history

The county's history is, like its geography, an epitome of England. The earliest inhabitants, hunters from the old Stone Age, have left traces in the famous Victoria cave at Settle. Agriculture, however, awaited other invaders centuries later. The Belgic 'Beaker People' have left their mark in the strangely irregular walled enclosures of Wharfedale. The Celtic tribe, the Brigantes, desperately but in vain resisted the Roman Legions. Even so, we still use their names for the rivers Ure, Wharfe, Aire, Calder and Don and for the city of Leeds.

The Romans left their mark mainly by their road communications. The Great North Road followed the magnesian limestone ridge. Other military roads radiated from York and Aldborough and there were many Pennine routes; some stretches of these are still in their original form. After the departure of the Romans, waves of invaders settled in parts of Yorkshire.

The Angles were probably first. Their adoption of Christianity and their decision to adhere to the Roman rather than the Celtic form had important consequences for Yorkshire. This secured the establishment of churches and monasteries which later had such a close association with agriculture.

Developments were at first slowed by strong Danish invasions, but in the space of a few centuries the newcomers merged with the Angles and West Saxons to form a united Kingdom of York. The term 'Riding' is the Danish 'Third' which followed the division of the Kingdom into the same three sections we know today. We can still detect the origins of settlements by place names—Selby, Slaithwaite, Appletreewick and Whitkirk were Danish. Barnsley, Bramham and Swinton were Anglo Saxon.

Monasteries

The Normans provided the manorial system and from this developed the 'three field' husbandry of early mediaeval times. From the period of the Norman conquest the monasteries achieved their maximum importance. Many Orders developed but outstanding were the Cistercian Abbeys. In the West Riding the largest was Fountains and it had a great influence on the development of agriculture and industry. Originally adopting a simple and austere system, the abbey became wealthy and owned a very large acreage of land, mainly in the dales. It organized farming, provided facilities for harvesting and grain storage, and developed sheep husbandry. The monks provided communal facilities for shearing and were instrumental in developing a thriving export trade in raw wool to Northern Italy; so originated the West Riding textile industry.

Geology and climate

Farming in the county is rigidly determined by elevation, climate and geology. The Pennine range extends from north to south. In the north-west a series of faults has revealed the carboniferous limestone complete with the famous 'limestone pavement', underground streams, caves and an interesting flora. Southwards, the Pennines comprise millstone grit and coal measures giving rise to inherently poorer soil conditions than those of the limestone. Eastwards, the narrow magnesian limestone belt runs north and south marking the boundary of the Vale of York. The magnesian limestone is a fertile, well-drained soil while the Vale of York and the lowland around Doncaster comprise an extraordinarily varied mixture of soils. This is the result of the area forming a glacial lake in former times with meltwaters from the north and east discharging material into a low-lying basin.

The Pennines reach an elevation of over 2,400 ft with correspondingly high rainfall. The Bowland Forest—a western outlier of the Pennines—is the wettest area with average rainfall of over 70 inches. The climate is also severe, limiting effective growth to a mere five months. It says much for the determination of West Riding farmers that such land can be profitably farmed. At the higher elevations only extensive systems of hill sheep and cattle are possible but wherever conditions relent dairying is undertaken. The harsh conditions around the industrial centre of the county do not deter the producer/retailer of milk. Though declining in numbers, this type of farmer continues to be characteristic of the West Riding scene.

The Dales, well known for their scenic beauty, are mainly within the National Park. They are becoming increasingly popular with the tourist

although the farmer has so far not benefited from this holiday traffic to any marked extent.

Living with mining

Around the industrial areas many small acreage holdings have now reverted to part time undertakings. Farming on the coal measures soils, as on the millstone grit, requires great efforts on the part of occupiers. It is this area which has seen extensive opencast mining since the early war years. Thanks to enlightened methods, land used for coal extraction is now being returned to agricultural use, little the worse and sometimes better for the experience. Deep mining with its newer 'long-wall' techniques, however, causes more severe subsidence problems than older methods.

Livestock

Dairying is the most important farm enterprise in the county, accounting for more than a quarter of the total production. Cow numbers at 109,000 have never been higher but producers have dwindled by a half in fifteen years. Though loose housing is gaining ground, most systems are based on cowsheds.

Amongst intensive livestock production, poultry both for egg and table is well represented. Formerly many chick hatcheries were to be found in the Aire and Calder valleys but this is an industry which has shown a marked concentration into fewer operators in recent years. Pig farming, traditional to the systems of the central and east of the county, is becoming a highly specialized industry; appropriately the Meat and Livestock Commission Boar Testing Station is located at Selby.

The arable zone

East of a line drawn between Ripon in the north and Sheffield in the south arable farming succeeds livestock as the main enterprise. The rainfall here is between 24 and 33 inches and in spite of tricky soils and drainage problems a wide range of crops is grown. Field vegetables, led by peas and carrots, are big scale crops which have been grown for processing outlets in recent years. Red beet, cauliflowers and an infant flower bulb interest are to be found south of the Humber but the root crop most widely grown and revered is the potato. Thirty-thousand acres are planted annually and as elsewhere there is an increasing interest in the demands of the processor. Two sugar beet factories serve the three Ridings from York and Selby. The arable areas have long been famous for their fattening of cattle using the 'Ings' (or riverside pastures). Intensive methods have proved popular and have been widely adopted.

Cereal growing has seen the expansion common to most English arable areas. However, this has not been accompanied to any great extent by monoculture. The crops available have been varied and long cereal runs are not called for.

The West Riding has many thriving agricultural organizations, including show and discussion societies. It shares with the other Ridings the Great Yorkshire Show and the Yorkshire Grassland Society. It is significant that in an intensely industrial county, farming more than holds its own.

Recently published in a new book which takes a look at

Agricultural Marketing and the E.E.C.

G. W. Ford

THE topicality of this long-needed study*, sponsored by the Home Grown Cereals Authority and the Meat and Livestock Commission, is obvious while the *great debate* is proceeding about the entry of the United Kingdom into the European Community. In or out of the Common Market the book will be of considerable interest to all concerned with farming and agricultural marketing in this country because the study not only describes the history and development in the E.E.C. countries of this subject, but it makes useful and relevant comparisons with the situation obtaining in the United Kingdom.

The work makes complementary reading with the same authors' earlier book, *Food, Farming and the Common Market* which was reviewed in *Agriculture* in November 1968.

With the tendency for agricultural support systems to develop greater emphasis on market needs, and with the possibility of greater competition from Common Market farmers, a mere comparison of farm gate prices of agricultural commodities is insufficient to determine the viability of farming in particular commodities. Today the processing, packaging and transport costs account for over 50 per cent of the retail price for many products. Accordingly, not only will British farmers have to be efficient and competitive but so must the marketing of these products. Moreover this marketing must keep abreast of the technological requirements of a dynamic market. It is in these matters that this study will be particularly valuable. The book deals with, inter alia, how agricultural marketing is organized in the E.E.C. and there are chapters about the arrangements that operate for each of the major commodities. The position and development of producer organizations are described, including the various types of co-operative systems, as well as the manner in which Community regulations affect the marketing process. How the Common Market countries in their different ways go about the operation of the commodity intervention arrangements to take specified produce off the market in periods of depressed prices is explained.

One point becomes especially clear: with the constant mention of *common* market, *common* prices and *common* management systems, one could conclude that everything is identical from the north of Holland to Sicily. This is, of course, far from being so and the book brings out the many differences. Indeed the Communities' common agricultural policy sets an overall legal environment and provides certain funds within which member states, farmers, traders etc. must operate, but within this framework there is in practice much

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**Agricultural Marketing and the E.E.C.* M. Butterwick and E. Neville-Rolfe. Hutchinson, 1971. £3·50.

scope for variation. Attention of course has to be paid to secure that any variations still enable farmers and the marketing to remain competitive.

One point to note especially is the role of the producers' co-operatives and the support given to agricultural co-operation by the Common Market. The development of co-operatives in the field of fruit and vegetables is encouraged: co-operatives are given a part to play in the intervention process when market prices slump. The expansion of co-operatives is one of the key points in the Mansholt Plan for structural reform of agriculture in the E.E.C. It was estimated recently that in the Common Market a million people actually work for agricultural co-operatives, of whom 600,000 are paid employees: also, that there are about 12 million members in some 50,000 co-operatives and of these over 20,000 are engaged in marketing*.

Finally, one of the appendices to the book gives a brief history of the agricultural marketing situation of the other three applicant countries, viz. the Irish Republic, Denmark and Norway.

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*A paper by Mr. Herlitska, Secretary General of C.O.P.A., delivered at the First International Congress of the Farm Management Association at Warwick University, June 1971.

G. W. Ford is the Ministry's Regional Manager at Nottingham and was Agricultural Counsellor to the U.K. Delegation to the European Communities in Brussels from 1965 to 1969.

Ministry Publications

Since the list published in the August 1971 issue of *Agriculture* (p. 370) the following publications have been issued.

FREE ISSUE

ADVISORY LEAFLETS

No. 235 Chafer Grubs (Revised)

No. 419 Spinach (Revised)

SHORT TERM LEAFLETS

No. 97 Weed Control in Peas (Revised)

No. 124 Towards More Profitable Weaner Production (New)

No. 126 Mechanized Handling and Feeding of Tower Silage (New)

No. 128 Handling Equipment for Indoor Potato Storage (New)

No. 130 A Guide to the Choice of Laying Stock (New)

FIELD DRAINAGE LEAFLETS

No. 1 Does Your Land Need Drainage (New)

No. 5 Grants for Field Drainage (New)

No. 9 Ditch Elimination (New)

UN-NUMBERED LEAFLET

Farm Safety—Tractors Overturning (Revised)

Single copies of these leaflets are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

Books

Salute the Carthorse. PHILIP A. WRIGHT. Ian Allan, 1971. £*1·50*.

A century ago, the horse reigned unchallenged in the fields. It had replaced the ox, but was not yet threatened by mechanical power. A generation ago, in the ploughing-up campaign of the early war years, it still provided a third of the farmer's draft power. Now it has passed from the contemporary farming scene to join its horned rival in agricultural history. It is fitting that someone who handled carthorses before he left school and trained at a Farm Institute equipped with teams of horses but only one tractor should say farewell to this faithful servant. It is equally fitting that he should do so in terms that record so much of the near-forgotten farming system which depended on literal horse-power.

He begins with descriptions of the four breeds of heavy horses and lists of farmers who still keep or breed them, continues with references to their management, feeding, harnessing, working routines, breeding and training, and ends with a chapter on traditional, sometimes bizarre, remedies for their ailments. He writes pleasantly, personally, and practically, with digressions on such interesting points as horse-driven thrashing gear, the removal of windmills to different sites by horse-teams, the London carthorse parade at which he broadcasts annually, and the stories of the supposed secret society called the 'Horseman's Word', of which he is politely and healthily sceptical.

In the days to come, this will be one of the books to which agricultural historians will turn for an understanding of the premechanical past. The book is illustrated with numerous photographs, supplemented by the author's sketches. Many readers will enjoy these pictures but few will enjoy them as much as those who remember the scenes they show.

N.H.

The Flora of a Changing Britain. F. PERRING. E. W. Classey, 1970. £*2·10*.

Dedicated botanists, naturalists and conservationists will acclaim the publication of this set of fifteen papers presented to the 1969 Conference of the Botanical Society of the British Isles. In the past few years the word 'environment' has acquired a strong currency with sinister overtones as realization of its supreme importance to the health, welfare and indeed survival of man and all forms of life are put at risk by progressive civilization. This is not to say, however, that all environmental changes are to be laid at the door of man's activities, nor that they are necessarily adverse; natural laws and agencies play their part in disturbing balances and patterns of associated life which at one time were thought to be immutable.

The contributors to the B.S.B.I. conference were invited to look at the main factors which have been imposing changes in the variety and populations of British flora, particularly in the past quarter century, and to relate them specifically to the influences of climate, land use, transport and chemicals. Indictment of man's activities is implicit in these papers—it would be remarkable if it were not so—because of indirect changes in climate, the modern concepts of farming and farm practices, the effects of a greatly extended network of road traffic, and the pollution of land, air and water, which Dr. Mellanby apostrophizes as 'our filthy world'.

Changes in the distribution and density of our flora, and some extinctions too, are carefully noted and analysed and explanations offered, but in an approach to the evidence, which is always praiseworthily objective, there are surprisingly no predictions or prophets of doom. Our nature reserves may be the final sanctuaries of certain rare species, but elsewhere, as Dr. Perring says, if members of the B.S.B.I. are concerned about the future of some 20 per cent of our native flora, it is of the greatest importance that conservation organizations, both official and voluntary, are made aware of the localities and appropriate measures taken. Neither does change work only one way: new environments can encourage certain of our native flora previously scarce and perhaps provide acceptable habitats for new species introduced from abroad.

S.R.O'H.

Farm Calculations. GRAHAM BOATFIELD AND IAN HAMILTON. Cassel, *35p*.

The authors of this book have approached their task with realism and a sound understanding of the difficulties confronting pupils in this discipline, many of whom are not mathematically inclined. The introduction sounds a note of encouragement for the student. 'In some of these calculations' it says, 'the old rule of "near enough is good enough" applies, and it is quite satisfactory to get to the nearest unit—pound, hundredweight or square yard. In others, particularly those in the machinery section, the answers need to be exact. The important things are to learn the methods, to think realistically, and to know when you can make a rapid calculation to get an approximate answer, and when you must take more time and trouble and aim for accuracy.'

A most useful aspect of the book is the worked examples given throughout the text. The pattern followed is to give an explanation of, and a reason for, the particular calculation; then to show clearly, step by step, the method of working the problem, and finally the illustration by a worked example. A number of practical problems relating to each section are given and answers are provided.

Decimal currency is used but the old weights and measures are retained. While this does not affect the basic principles, it would perhaps have been better to fall into line with the schools, which are now teaching metrication. This apart, the book is of considerable value to students of farming at any level.

J.A.S.

Agricultural Chemicals Approval Scheme

There are no Additions or Amendments to the 1971 List of Approved Products for Farmers and Growers this month.

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Ministry of Agriculture, Fisheries and Food

SELECTED PUBLICATIONS

Dairy Floors

Prepared by a sub-committee of the Milk and Milk Products Technical Advisory Committee, this report will be of interest to everyone concerned with the dairy industry. Architects, builders, plant designers, management and dairy technicians will find it a useful guide to all aspects of dairy floors. The main subjects covered are design; materials available; special considerations for various parts of the dairy; maintenance and repair. It contains a good bibliography. Illustrated.

40p (44½p)

Farm Buildings Pocket-Book

Since the first edition of the pocket-book was compiled there have been many developments affecting the accommodation of livestock and the storage of produce and materials on the farm. This revised edition gives what are accepted generally as the standards applying today.

17½p (20p)

Commercial Glasshouses

This revised and illustrated bulletin deals comprehensively with the many developments which have taken place since the third edition was published in 1960, a time probably of more rapid change than in any similar period in the history of the glasshouse industry. Choice of site and nursery layout, glasshouse types, construction and materials, are all fully discussed, and in addition to advice on ventilation, considerable attention is given to the requirements of various types of heating systems. (Bulletin No. 115)

62½p (70p)

Bulk Storage of Potatoes in Buildings

Discusses the siting, design and construction of buildings for the storage of potatoes in bulk. This illustrated bulletin also deals with insulation and ventilation and the questions of mechanical handling and managing the crop from the time it is put into store until it is marketed. (Bulletin No. 173)

22½p (27p)

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